DAVID GANS (1541-1613):
Disciple of Maharal of Prague; Assistant to Tycho Brahe and Kepler
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Part 3
DAVID GANS: ASTRONOMER

1. GENESIS OF THE INFINITE: THE ASTRONOMICAL REVOLUTION IN THE 16TH CENTURY

Exodus to the Infinite: this is the definition we have given to the discovery of America for the mind of man in the 16th century. If one wanted to attempt to define, in a symmetrical formula, what the astronomical revolution represented for this same man of the 16th century.

If one were to attempt to define, in a symmetrical formula, what the astronomical revolution represented for this same man of the 16th century, marked by the names of Nicolas Copernicus (1473-1543), Tycho Brahe (1546-1601), Johannes Kepler (1571-1630), and Galileo (1564-1642), one would undoubtedly find no better expression than "Genesis of the Infinite." Indeed, in the 16th century, astronomy reveals to the Infinite the dimensions of a universe that human reason had closed off and walled in within the immutable frames of the Finite more than a millennium earlier.

There too, it is a Re-birth, in the true sense of the term, for there was a time when the conceptions of the universe were tinged with Infinity. But that time had faded into the distance, human memory had worked to erase it, just as America had once existed and then disappeared from the human orbit, just as, to a lesser degree, the canons of ancient art had illuminated Athens, Rome, and Alexandria, only to nestle into ruins. And for the man of the 16th century, the passage to infinity, in the field of astronomy, was not equivalent to the rediscovery of an ancient theme, but to the genesis of a new rhythm.

But, as with the new earthly world, the discovery of the new celestial world was not the work of reason alone. It was shaped by the joint push of reason and mysticism; it too was an adventure in which the transcendence of reason by a meta-reason, the intimate connection of reality and myth were, in every respect, decisive and significant.

NEW ATTITUDE OF THE ASTRONOMICAL MAN

From the Closed World to the Infinite Universe; The Sleepwalkers: these two titles chosen by Alexandre Koyré and Arthur Koestler[1], respectively, are enough on their own, in their striking

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[1] 1. A. Koyré: From Closed World to Infinite Universe, Paris 1960. — Id.: The Astronomical Revolution, Paris, 1961. — A. Koestler: The Sleepwalkers, Paris, 1960.

complementarity, to define the spirit of the adventure of astronomy in the 17th century that these authors have described with as much logical erudition as poignant elevation.

Humanity indeed knows few adventures as architectural in their revolutionary scope on one hand, and as fantastical on the other, due to the wild romanticism of those who were its heroes.

Geometric architecture, leading from Nicolas Copernicus (whose unique yet decisive work, bearing the term revolution in its very title, was published in the year of his death, in 1543) through Tycho Brahe and Johannes Kepler, up to Galileo, born in 1564 and who died in 1642 (the very year Isaac Newton was born), represents, over exactly a century, from 1543 to 1642, an apparently linear progression, a slow but tenacious erosion of the Ptolemaic system that for over a millennium had walled the world in on itself, placing the immobile Earth at the center of a kind of grand clockwork movement, made up of the circular orbits of the planets revolving around it with a complex yet intangible regularity.

We have apparently said linear; for nothing would be more false than to adhere to the common belief in a scientific evolution, set in motion by Copernicus's "nudge," which was enough for his successors to extend to the five fingers of the human hand.

It should be recalled first that by substituting Ptolemy's geocentric system with a heliocentric system, Copernicus was merely putting forth a purely mathematical hypothesis. He had not supported it with any concrete observation, for the simple reason that astronomy still had to take the giant leap that would lead it from the abstract to the concrete. The first observatories will only emerge at the end of the 16th century, fifty years after Copernicus. The most equipped among them was that of Tycho Brahe, on the island of Hven, in Denmark, then in Benatek, near Prague, where Kepler worked following Brahe, without either of them, in fact, providing verification of the Copernican "revolution." Only the telescope, invented by Galileo in 1609, was able to provide physical evidence, while until then pure mathematics reigned as the absolute sovereign. In the end, Copernicus was still captive to the Ptolemaic universe, and everything had happened as if the fall of the Bastille had not been carried out by an assault from the outside, but dreamed by the prisoner in one of its cells. One of the dominant facts in the evolution from 1543 to 1642 is not the expansion of the Copernican hypothesis in the history of astronomy, but rather the increasingly significant role that the observation of the sky occupies in this history, rather than mere numbers. Instead of continuing to focus on the Tables and, literally, on the work table, the *homo astronomicus* would now lift his eyes to the sky. This marks the first aspect of this breakthrough from the "closed" world of Ptolemy to the "infinite universe" opened by Copernicus.

The second aspect derives from the first as a logical corollary. By raising his eyes, the man was about to be seized by that physiological, psychological, and moral shock that the purely physical sensation of abandoning inertia provides, and which we call vertigo. The vertigo that the architects and builders of Gothic cathedrals already knew in the Middle Ages. One can find traces of it in the sketches of architects, torturing and breaking the regular circles of the Romanesque period to bring forth these ribbed vaults, these flying buttresses, these facades, these towers, these spires, all as so many Babel-like upheavals of the established horizontal order, to rise higher, ever higher, as if one wanted to tear the earth from itself and offer it to the sky. One

can sense the repercussions in the daily and relentless toil of the masons, sculptors, and workers, risking everything—their safety, their comfort, their lives—to bring the architects' dreams into the reality of stone. A whole people striving for a revolution that will consume entire generations, which often, after these centuries of toiling work, will remain unfinished, like the cathedral of Strasbourg, with its unique tower, warning like a stern finger that human awakening has insurmountable limits, or like that of Cologne, a struck monster, whose carcass will remain until the 29th century, like a sort of modern Tower of Babel, nailed in place by the very divinity that was meant to be honored. But at least this dizzying audacity of the cathedral builders was, in the Middle Ages, confined by the very thing it served, namely the Catholic and Roman Church, with its authority, its grandeur, its serene patience, and its unwavering certainties. It was a hurricane in a glass, and even if that glass had the dimensions of the cosmos, it remained that its walls were perfectly defined and of an unwavering stability. The vertigo of cathedrals had been triggered in a closed environment. It was a muted vertigo, and, to some extent, calmed by the feeling of security provided by the grandiose inertia of the Church.

Now, it is the cracking of one of the main components of this inertia that would be triggered by the astronomical revolution in the 16th century. The Church indeed based its conception of the cosmos on that of Ptolemy, feeling all the more reassured by the Ptolemaic model, as it shared it with the entirety of medieval humanity in Europe, particularly with the Jews and Arabs, from whom it had inherited it. And nothing offered, indeed, more security, both human and otherwise, than the system of Ptolemy, who himself was the heir to that of Aristotle and, to a lesser degree, that of Plato. That accommodating certain biblical models, closer to monotheistic thought than Greek models, changed nothing. Whether it was conceived like the Tabernacle from the biblical Book of Exodus, or like the City of God described by Saint Augustine, or more rationally imagined in the Aristotelian manner of spheres turning like wheels or in the Platonic manner of realms graduated in rungs of ladders, the universe of Ptolemy (and that of Avicenna, Maimonides, and Saint Thomas Aquinas) was static and closed upon itself.

At the center lay the Earth. Whether plate or round, it didn't matter. The essential thing is that it was at rest — the first element of reassuring stability for its inhabitant, man — and also that it was at the center — the second element of security since only the ideal geometric figure required by the center could evolve around this center, namely the circle. The circular depiction of the movement of the stars and the central immobility of the Earth: these are the elements of inertia that would soon dazzle the eyes of the *homo astronomicus* in the 15th century, not all at once, but through a back-and-forth and a commotion capable of inducing a vertigo that could no longer be calmed by either the safeguards of the Church or those of philosophical reason, which was also a faithful servant of the Ptolemaic system.

Whether it was the spectacular push from Copernicus, tearing the Earth from its rest and launching it into space, or the more discreet gesture of Kepler (without which Copernicus's actions would have been meaningless) moving from the circle to the oval, and then to the ellipse, there was enough to intoxicate those who witnessed the spectacle, and foremost among them, those who occupied the stage. Yes, we must face the facts: Copernicus, Tycho Brahe, (Kepler) Galileo are "sleepwalkers," a term that is not derogatory but perfectly describes the hybrid nature of their genius.

A FEARFUL REVOLUTIONARY: COPERNICUS.

Without a doubt, Koyré is right to reproach Koestler for his almost caricatural portrait of the "timid canon" of Frauenburg, working in his lost province by the shores of the Baltic with makeshift instruments, in a suspicious solitude towards everyone and, to begin with, towards his own discoveries, to the point that even today, the historian would have the right to wonder if the *Book of the Revolutions of the Celestial Orbs* is not a hoax worthy of the age of Rabelais. "It is very difficult, nowadays, writes Koyré, to understand and appreciate in their true magnitude the intellectual effort, the audacity, and the moral courage represented by the work of Copernicus."

Certainly, but this difficulty stems from certain aspects of character, not of the work itself, which have undoubtedly been exaggerated by Koestler, but are undeniable in their mysterious simplicity. Here is a man who studied in Krakow, Bologna, and Padua, in Ferrara where he became a doctor of canon law; a man who found himself in Rome during the *jubilee* year of 1500, that is to say, at the place and moment of gathering of all the scholars, humanists, artists, and enlightened patrons that Europe had to offer at that time, all eager for new insights on everything; a man who, in this climate where radical changes are preparing to shift the Middle Ages into the modern world, rediscovers Aristarchus and his heliocentrism and who, dazzled by this overturning of the Ptolemaic system, immediately begins to put on paper, as early as 1507, the fundamental propositions of his own heliocentric reinterpretation of the universe, but will hide his notes, his files, his observations, his manuscript in the secrets of his drawers in the northern tower of Frauenburg, taking 36 years to give them a form he deems worthy of being submitted to the printer. When the book is sent from the presses of Nuremberg to its author, he is dying in his fortress of Frauenbourg. He died on May 24, 1543, taking with him to the grave at least two enigmas: one being a dedication to Pope Paul III, written in June 1542, in which Copernicus pays tribute to those who ultimately encouraged him to publish his book, simply forgetting to mention his sole, his unique, his faithful disciple, Rheticus, without whose persistent efforts the "Book of Revolutions" would never have gone to press; and the other enigma being a Preface, which is likely in Osiander's hand, but which Copernicus could still have corrected in proof and whose content he had approved. Or, this preface warns the reader, in the finest Rabelaisian style, that everything they are about to read is merely a series of hypotheses, filled with absurdities, yet worthy of being presented on the same level as the absurd hypotheses of the Ancients. That one should not accept as true ideas conceived solely for mathematicians and not for astronomers, philosophers, or theologians "for fear of coming out of this study more foolish than one entered."

What was Copernicus afraid of? It would be a mistake to believe that he feared the wrath of the Church, the Inquisition, the stake. At that time, in Rome, we were still far from the mistrust that Galileo would fall victim to almost a century later, following the imperious measures demanded by the Counter-Reformation. Moreover, what could have emerged from his theories, during Copernicus's lifetime, was criticized much more by the Reformers, by Luther and Melanchthon, than by the Catholics. And, from a purely political standpoint, Copernicus and his peers were in their distant province of Ermland, sheltered from the fratricidal struggles that were beginning to shake the Church. One of the few close friends of Copernicus, the canon Tiedemann Giese, who

later became the Bishop of Ermland (mentioned in the Preface to Paul III), could afford the luxury of publishing, in 1525, a plea for tolerance and reconciliation, the letter-preface of which mentions the name of Copernicus and contains the famous declaration: "I refuse to fight."
But if, like Giese, Copernicus could refuse to engage in battle with the opponents of his "revolution," he could not evade another fight. Who was Copernicus afraid of? we ask ourselves. Of himself, of his calculations, dizzying breakthroughs in a universe where one could not move forward without asking, with Erasmus, who was at work in this exploration: reason or madness? In a certain sense, Koyré and Koestler converge in their portrayal of Copernicus. The "Book of Revolutions" is not the result of a joke, but the consequence of a tragedy. Only, this tragedy unfolded in such intimate regions of Copernicus's soul that, seen from the outside, it has all the appearances of a farce. Indecision, evasion, masquerade: these are the psychological defense reactions of a mind desperately trying to convince itself that it is not crazy. These are also the grotesque grimaces hiding, as best as they can, the inner tear of a soul rendered unable to scream its pain. Copernicus is the Rigoletto of one of the most dramatic phases of this 16th century of the Royal Spirit. The man was having fun by assassinating the children of his closest friend: Reason.

A GREAT LORD: TYCHO BRAHE.

Compared to Copernicus, Tycho Brahe is a great lord. He is the condottiere of the astronomical revolution, just as his disciple and immediate successor, Johannes Kepler, is its magician.

Tycho Brahe's project was ambitious yet simple: to achieve a compromise between Ptolemy and Copernicus, creating a universe where the Earth would remain central and motionless, but where nonetheless the main planets, with the exception of Earth, would revolve around the Sun. To reach this compromise, there is only one path: the observation, the precise, meticulous, tireless observation of the sky. The "career" of Brahe, if it is possible to refer to such a brief and tumultuous existence in this way, but which nonetheless builds itself according to a social hierarchy transforming a Danish nobleman into the undisputed prince of the realm of stars, the career of Brahe, I say, began with the observation, in 1572, of a new star that we mentioned earlier. It was going to continue relentlessly and without detours in this increasingly vast exploration of the sky.

But to traverse this path of observation, Tycho Brahe needed complicated and expensive instruments, numerous collaborators who had to be well-paid, and unlimited leisure, as required by science when it demands patience, but golden leisure that frees the researcher from material worries. All of this, Tycho Brahe found in abundance, knowing how to make excellent use of it. Copernicus lived alone and frugally in his unknown tower, known to no one. Tycho Brahe's tint, four times over, royal astronomical court, then imperial, in the company of a multitude of things, men, and, we might say today, research grants, as no scholar had ever known before him. The observatory, the first of its kind in the history of astronomy, which he had built according to his own designs, radiates with its splendor throughout the Renaissance, much like the Sistine Chapel: Uraniborg, the castle of Urania.

It was an observatory made entirely of detachable parts, and Tycho Brahe was able to set it up successively in two different locations, whose names are also inscribed, thanks to Uraniborg, among the brightest of the Renaissance: the island of Hven, also called "Venus Island," between Copenhagen and the castle of Elsinore; and the castle of Benatek, also nicknamed "The Bohemian Venice," ten leagues (35 kilometers) northeast of Prague.

In the Isle of Venus, Uraniborg operated for twenty years, from 1576 to 1596, thanks to the enthusiastic generosity of King Frederick II of Denmark. In the Bohemian Venus, Tycho Brahe reigned for only two years, from June 1599 until October 24, 1601, the date of his premature death, in the role of mathematician to His Imperial Majesty Rudolf II of Habsburg. However, Uraniborg continued to exist, as did Benatek, for on November 6, 1601, Tycho Brahe's disciple, Johannes Kepler, was appointed imperial mathematician and was to remain in that position until the death of Rudolf II in 1612.

It was the end of Tycho Brahe's dream, not only because Kepler, while remaining the mathematician of Rodolphe's successor, Emperor Matthias, had to leave Benatek and retreat to Linz, but also and above all because the same Kepler, while sincerely protesting his loyalty to Brahe, had, since the Master’s death, completely dismantled his system and built a new astronomy based on a physics that Tycho Brahe had entirely ignored. End of a dream! We said that it took Tycho Brahe to achieve this with patrons, wealth, and leisure: he found them in Denmark and Bohemia, like no scholar before him, like none of his contemporaries. He also needed technical aids, dedicated collaborators, each focused on precise observations, capable of adding a fixed star to the great bronze globe that lay in the library of Uraniborg, as their exact positions were pinpointed through observations and calculations.

These patrons and assistants, Tycho Brahe had found them in Denmark. He was going to meet them in Prague. Among the patrons, at the forefront, is Emperor Rudolf II of Habsburg himself. The bait had been cast by Tycho Brahe according to the best methods of modern advertising. He had printed, in 1598, a magnificent album containing (illustrations, poems, notes, digressions to support) a description that was quite alluring of Uraniborg and the instruments that its Master had installed there: *Tychonis Brahe Astronomiae Instauratae Mechanica, Wandesburgi*, 1598. It is through this folio that we know the date and content of Galileo's inaugural lecture at the University of Padua in 1592, which we mentioned earlier included commendations of Copernicus and Tycho Brahe.

Now, this volume, Tycho Brahe had the ingenious idea to dedicate it to Emperor Rudolf. He, flattered in his self-esteem as an astrologer-astronomer, hurried to take the succession of the sovereign of Denmark and made Tycho Brahe his imperial mathematician. Tycho Brahe's arrival in Prague in June 1599 was a princely cavalcade, and soon, Uraniborg was established at the castle of Benatek, near the capital, allowing Brahe to partake in the intellectual and social life of

the Prague astrologer-astronomer, hurried to take the succession of the sovereign of Denmark and made Tycho Brahe his imperial mathematician.[2]

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Among the assistants, one of those who had been his companion on the island of Hven and who had since gained a well-deserved reputation in the world of astronomers was Longomontanus (Christen Sévensen Longberg); a newcomer who had initially been nothing more than a researcher focused on the most rebellious of the planets, that of Mars, and on the development of new astronomical tables, but who would quickly overshadow all the others: Johann Kepler, two mathematics professors from the University of Wittenberg (Melchior Joestelius and Ambrosius Rhodius); more modest collaborators: Johannes Eriksen, Simon Marius, Mathias Seiffart, Poul Jensen Coloing, our David Gans; finally, the mathematician of the Elector of Brandenburg, Johannes Muller; of the entire Benatek team, he is the only one mentioned by David Gans in the *Nehmad Venaim*, alongside Tycho Brahe and Johannes Kepler.

A TYCHO WHO GOES FURTHER: KEPLER

The dream of Tycho Brahe had reached far. Just as Nietzsche would later assert that he was the last of the philosophers, having closed the loop once opened by Pythagoras, so too was Tycho Brahe convinced that he was the last of the astronomers, also closing the loop that had been opened in Greece long ago. A huge mural covered a wall of his study in Uraniborg. She represented the eight great astronomers of history, from Timocharis to Tycho Brahe himself, followed, however, by the ultimate of the ultimate, who had not yet been born but was already baptized. His name: Tychonides, the epigone who would synthesize the work of the Master and affix the seal of the absolute to it. Now, Kepler believed he had discovered Tychonides, and Kepler would indeed never have been Kepler if he had not known Tycho Brahe, the man and the work. But when, after Tycho's death, Kepler would logically have become a Tycho supporter, he effectively imposed the seal of the absolute on Tycho Brahe's system. However, this seal

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[2] Above, p. 18. Among the prose and verse praises included by Tycho Brahe in his volume, he features, "in order to fill a half-page left blank by the printer, a letter received from Padua." A friend, who wishes to remain anonymous, recounts how the doctor Jean Vincent Pinelli, one of the most famous patrons of Padua, had given his patronage to Galileo's inaugural lecture on December 7, 1592, in a packed amphitheater. In front of an enthusiastic audience, Galileo presented Copernicus's theories and praised Tycho Brahe's contributions and instrumental observation in astronomy. According to Emil Wohlwill: *Galilei and his Struggle for the Copernican Doctrine*, Wiesbaden, 1969 (2), I, p. 119, Tycho Brahe's book is the only historical document mentioning this inaugural lesson by Galileo. Let us note, in passing, that in the two large volumes of his book, Wohlwill makes no mention of Joseph Salomon Delmedigo among Galileo's listeners, nor, in general, of Jewish students at the University of Padua, which he does highlight for its cosmopolitan and open character, but "forgets" the Jews in the list of foreigners or non-Catholics enrolled in Padua for their higher studies. However, between 1517 and 1619, nearly 80 Jewish students graduated in medicine from the University of Padua (Alter, 8), a figure that is certainly not negligible.

betrayed the mark of such an original genius that Tycho himself would no longer have recognized himself in this system, which paid homage to his own by shattering it. Tychonides was born dead and from his ashes Jean Kepler was resurrected just as eternity would identify him.

The prestigious influence of Tycho Brahe, his feudal authority, his royal domain were too powerful and vast for Kepler, after his premature death, to be anything other than a disciple and a faithful epigone of the Master. But Kepler's hands and eyes were imbued with such magnetism, his thoughts were bubbling with such genius, that his "completion" of Tycho Brahe's system was, in reality, a radical transformation of the data and objectives of that system. To everything he touched, he left an original mark. To everything he prolonged, he imposed a new, unexpected, and unfinished direction, leaving it to others, to Galileo and especially to Newton, to definitively refine laws that already completely replaced those of Ptolemy, but were still expressed in that hybrid form that characterizes the entire 16th century: a mixture of certainties and anxieties, of logical rigor and lyrical abandon, of physics and metaphysics, of reason and mysticism, of lucidity and superstition, of mathematics and hallucination, which would provoke the most contradictory reactions.

THE REACTIONS TO THE REVOLUTION.

How did man in the second half of the 16th century and the beginning of the 17th century react to this astronomical revolution? In very different ways, of course, but we must categorize them carefully in order to understand the Jewish reactions and, in this area as in the discovery of the New World, to challenge clichés, restore the facts, and attempt to provide an accurate picture of Jewish humanism. The precaution is all the more necessary here since the Rema, the Maharal, David Gans, and Azarya dei Rossi were not, as in the case of America, late harvesters of an early sowing, but the immediate contemporaries of Copernicus, Tycho Brahe, Kepler, and Galileo, both in time and space, in Krakow, Prague, and Italy. The repercussions of the astronomical revolution on the surroundings of the great astronomers were thus known and felt by them. We will examine to what extent they shared them.

The most common idea we have about the reception given to the theories of Copernicus and his successors is that these new systems faced fierce opposition from the Church. The decree of the Holy Office condemning Copernicus's book in 1616, followed by the trial against Galileo in 1632 and his condemnation the following year, would be seen as the solemn outcomes of this long and violent struggle between Science and Religion.

Or, there was a struggle; intolerance and fanaticism came together against the scientific revolution, certainly, but it must be understood that, far more significant than this ideological battle, was, from the very beginning, another reaction: that of laughter, the thunderous and Rabelaisian laughter, which does more harm than criticism, the whistle of the spectator that drives the actor off the stage, the flick administered in the form of a pamphlet that cloaks the targeted author in a ridicule from which they may never be able to free themselves. It is known that Copernicus lived in perpetual fear of sarcasm, and this psychosis, too justified by the number of jibes directed at him and his theory, was passed on to those who adopted this theory, less so to

Tycho Brahe, who himself possessed a grand ability to mock everything and who responded to a mean word with an even meaner one, than to Kepler, who was in a constant state of anxiety, concerned with preserving his intellectual dignity amidst a life too often mired in ridicule and begging, and especially to Galileo, who lived in the constant dread of being ridiculed as Copernicus and his book had been.

THE LAUGHTER: MARTIN LUTHER

In this concert of laughter, the dominant note is provided by Martin Luther, and we know how much a word from Luther, expressed in the vulgar and coarse language he had a knack for and wielded skillfully, as a cunning and effective diplomat, had an impact on the mentality of his century.

An explosive word from Luther was likely to steer history towards its destinies. His terrible diatribe against "the Jewish pestilence" set back the emancipation of the Jews by two centuries and kept them in a social and political Middle Ages until the French Revolution. It's a word of this kind, directed against Copernicus, even before the publication of his book in 1539, that builds its massive dam against the emancipation of astronomy: it too will have to wait two centuries, until Newton, before being definitively freed from the heavy burden of ridicule that Luther's word imposes on it.

"It was thought of a new astrologer, who wanted to prove that the Earth moves and revolves, not the sky or the firmament, the sun and the moons; just as if someone were sitting in a wagon or a ship and is being moved, he would think he is still and at rest, while the ground and the trees move around and are in motion." But it is now as follows: whoever wants to be clever should not let him take pleasure in what others do; he must create something of his own, and it must be the very best, no matter how he does it. The fool wants to overturn the entire art of astronomy, but as the holy scripture indicates, Joshua commanded the sun to stand still and not the earth.*.

We will highlight, in Luther's diatribe, first of all the insult, this term "Narr," which since Erasmus and Sebastian Brandt has implicated those to whom it was applied in the terrible promiscuity that haunted man in the 16th century as much as it fascinated him: that of genius and buffoonery. We say buffoonery and not madness, because with a madman, one knows he is ill, and in the 16th century, it was thought to be incurable. But the jester was, at that time, this hybrid being who could afford to say anything, the most august truth mixed with the most absurd folly, without anyone paying attention to his perpetual ramblings, since, gathering the crumbs under the table of the sovereigns, the jester had the well-defined role of simply making people laugh. Tycho Brahe had attached to his royal domain of Uraniborg such a jester, the dwarf Jeep, and listening to him cackle... Ceaselessly, one could gather from his mouth the most blatant nonsense, but also mathematical precision, numbers, equations, which guided the mind towards the most serious realms of astronomy. But what Tycho Brahe could afford Like kings gathering snippets of political or moral science from the mouths of their jesters, because he had made astronomy his "polis," a Copernicus, a Kepler, a Galileo were not equipped to live with it without suffering, and without their discoveries suffering as well. To place before them a jester who mimicked their image was to strike at the weakest point of their vulnerable armor. For more than two centuries, anti-Copernicanism was largely based on this suspicion of buffoonery. We have,

moreover, indicated earlier how Andreas Osiander contributed, while Copernicus was still alive, through his preface, read and approved by the author, to cast this dreadful doubt of farce over Copernicus's book. Or, Osiander was one of Martin Luther's companions from the very early moments of the Reformation. In any case, this big laugh will accompany, whether loudly or softly, the astronomical adventure up to Newton.

THE AUTHORITY OF HOLY SCRIPTURE: MELANCHTHON AND THE HOLY OFFICE,

But Luther's burst of laughter ends with the invocation of the Holy Scriptures, of its authority, especially that passage from the Book of Joshua which would prove fatal to the Copernican system and lead to its explicit condemnation for the first time in 1616, and implicitly, through Galileo, in 1632. This is the second barrier imposed on the astronomical revolution. Next to laughter, the Inquisition. And this is the whole problem of intolerance that is thus raised. But it is also important to nuance things, presented in a thousand ways depending on the personal choice made by the historian. The Catholic historian, concerned with defending the honor of the Church, will rightly emphasize that Copernicus's book was placed on the index only three-quarters of a century after its publication, that during his lifetime, Copernicus found followers and even admirers among high-ranking Church officials, that Pope Paul III had deigned to accept the dedication of this "Revolution of the Celestial Orbs," and finally that Galileo's trial was conducted with tact, without causing scandal, and with a concern for fair treatment. Nevertheless, Copernicus's book and, with it, his entire conception were condemned by the Holy Office, in the name of the Church, that Galileo was forced to pronounce the solemn formula of abjuration, under the threat of torture, that from the beginning of the 16th century, at least, the Catholic Church exhibited a dogmatic and monolithic intolerance towards the Copernican thesis. Is it she who, until the beginning of the 16th century, fought for the authority of Scripture against science?[3]

But the Catholic historian is certainly not wrong when he reproaches the Protestant historian for presenting the astronomical revolution as if it had emerged from within the Reformation, of which it would have been one of the most beautiful fruits, naturally arising from the climate of freedom introduced by the Reformation in the Church. We have just heard the scriptural argument wielded by Luther; Melanchthon will be more severe. He will wield against Copernicus the arguments of absurdity and Scripture, like Luther, but he will add that severe measures should be taken against this impious doctrine.[4]

Severe measures? The Protestant anti-Copernican pressure was constant and brutal throughout the second half of the 16th century to the point that Johannes Kepler, who was himself a reformer, had to defend himself against both sides in 1609 in his introduction to *Astronomia Nova* with this courageous affirmation:

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[3] Copernicus's book was removed from the Index only in 1835.

[4] P. Melanchthon: *Initiation of Physical Doctrine*, Wittenberg, 149, p. 60 and following, p. # and following. See Koyre, Le.

"Here is for the authority of the Holy Scripture," As for the opinions of the saints regarding natural matters, I will respond in a word that the weight of Authority matters in theology, but in philosophy, only the weight of Reason counts. Done, Saint Lactantius, who denied the roundness of the Earth; Saint Augustine, who accepted the roundness but denied the antipodes. Sacred is the Holy Office today that acknowledges the smallness of the Earth, but not its movement: but for me, more sacred than anything is the Truth when, with all the respect I owe to the doctors of the Church, I demonstrate according to philosophy that the Earth is round, inhabited all around by antipodes, of a very insignificant smallness, and that it travels swiftly among the stars."

These few lines from Kepler are a cry, just as Galilee's will be thirty years later, a cry of alarm, but one that will not be heeded any more by the Protestant Church than Galilee's will be by the Catholic Church. As we know, as soon as the Thirty Years' War breaks out and the fateful moment arrives when one must declare allegiance to one camp or the other, Kepler, suspected and persecuted, with his mother accused of witchcraft, ultimately finds himself deprived, on his deathbed, of the Sacraments, excommunicated in the sense that this term could have in the Lutheran Church, just as Galileo was, to a certain extent, excommunicated by the Catholic Church.

THE AUTHORITY OF REASON: BACKGROUND. THE CARTESIAN OPPOSITION

But let us now be careful not to fall into the benign seductions of the secular historian, the enlightened philosopher. He has the upper hand in dazzling us with the "tolerance" of reasonable people in contrast to the "intolerance" of churchgoers. The cry of Kepler could serve as a reference for him, this Kepler who so judiciously opposes Reason to writing. In reality, Kepler, and before him Copernicus and Brahe, and after him Galileo, had to suffer from Reason as much as from the Church. For as great, if not greater than the authority of the Church, was that of Aristotle in the 16th century. The Ptolemaic system, shaped, softened, and rounded by the successive hands of Averroes, Maimonides, and Saint Thomas Aquinas, was an integral part of this artificial yet grandiose work of art, imaginary yet unassailable, in which Reason, daughter of Aristotle, had been walled in!"medieval universe, It was even one of the master pieces, for it is within these solid and stable walls that the Bible and Reason were able to conclude the reassuring pact of their concordance." Physics and metaphysics converged into a whole that no worry could disturb. The most pressing problem in the field of metaphysics, that of the origin and nature of Evil, was resolved, since Evil was relegated to the only sublunar part of the world. And the most pressing problem of physics, that of the forces driving planets and stars in their movements, was solved! You too, by the certainty of a Divine Will making the world operate like an astronomical clock. Medieval Reason had certainly faced dangerous threats. Metaphysical positions had been assigned to Evil, placing it even within God Himself, which simultaneously shattered the Aristotelian hierarchy and brought forth, in diffuse intuitions, the elements of the pre-Aristotelian Greek universe, which Copernicus, shortly preceded by Nicholas of Cusa, would take up for his own and pass on to his successors. But these tremors came from the side of Mysticism: when it was Jewish, it was derisively labeled Kabbalah, deemed unworthy of being listened to by a reasonable mind; when it was Christian, it was quickly stifled, swept away from Schools and Universities, and relegated to its cloisters, if it was not simply declared heretical and condemned to the flames. Even within Judaism, as we have seen, Kabbalah had to remain

clandestine and did not dare to reveal its presence to challenge philosophy on equal terms, at a time when the astronomical revolution was taking place in the second half of the 16th century.

Thus, throughout the 16th century, Aristotle continued to be invoked against heliocentrism, as much as, if not more than, the Bible. The discovery of New Worlds, the horizontal reshaping of the Earth did not change anything: we have seen that the movers and proponents of the maritime Exodus towards Infinity found access to the human mentality only at the very end of the 16th century. The Reformation did not change anything either: Melanchthon, as we have also seen, bases his severely anti-Copernican argumentation on the authority of Aristotelian physics and that of Holy Scripture.

The Sorbonne was not the only university that remained medieval during the height of the Renaissance. In Italy, in Germany, in England, the learned, the scholars, those dear professors, unanimously swore by Aristotle and Reason against the absurdities of the new astronomy. The tone will be set, in a sort of flashback, in the midst of the 16th century, by Descartes, a genius mathematician and physicist, but also a philosopher, the archangel of that "common sense" that Melanchthon had also invoked a hundred years earlier. The criticism of Kepler and Galileo by Descartes undoubtedly constitutes the most virulent and symptomatic rear-guard battle in this tenacious struggle of Reason against Truth.

FROM PASCAL'S STRUGGLE TO DAVID GANS' WONDER.

And, following in the footsteps of Descartes, Pascal, a mathematician, physicist, and philosopher as well, joins in. Not because he trusts this Reason with which his mystical soul cannot reconcile. But because with a clarity that the Masters of Jewish Kabbalah already possessed, he foresees to what extremes the new universe disorients the position of man. This man, already so small before the Divine Infinite, here he is even smaller, reduced to the atom within the Cosmic infinite. The Earth, once set on its adventure, is in a perpetual sway between the Infinites for the earthly inhabitant, a giant on its crust, a grasshopper on its path. If Descartes finds fulfillment in the cozy crown of his common sense, Pascal trembles for his fate. "The silence of these infinite spaces terrifies me..." And indeed, it is necessary to place Pascal's fear, alongside the dam of Reason and Theology, and alongside Luther's laughter, among the reactions through which, for more than a century, the cultivated and modern man has welcomed the astronomical revolution.

But there is one last reaction, direct, simple, moving: *wonder*.[5] Let us say right away and in a prelude sentence that we now have four motivations for this warm welcome of the astronomical revolution, the acceptance of its movements as a new but wonderful revelation, confirming the old one, that of Sinai, which we find on the side of the Jews.

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[5] When he applies to science his beautiful variations on wonder, a key concept of his theology, Abraham J. Heschel specifically cites the astronomer as a witness to a learned "wonder" in the face of the laws of nature (Abraham Heschel: *God in Search of Man*, *Philosophy of Judaism*, Paris, 1968, p. 119).

2. ASTRONOMICAL PREPARATION: DAVID GANS AT THE THRESHOLD OF THE REVOLUTION.

How was the astronomical revolution felt by the Jews? This is a question that we will attempt to answer now.

Do I need to point out right away, after all that we have said so far about David Gans, that it is in his book *Nehmad Venaim* that we discover this attitude of wonder in his broadest and most nuanced range of responses?

Among the Jews at the end of the 16th century, he is the only one who had the privilege of personal and close contacts with Tycho Brahe and Johannes Kepler. It is true that at the same time, Joseph Delmedigo was attending Galileo's lectures in Padua and that the book *Elim*, in which Delmedigo takes into account the views of "his master Galileo" for the description of Jewish astronomy, was published in Amsterdam as early as 1629, even before Galileo's trial.the immaculate freshness of the "revolution," while it will take more than a century for David Gans' book to finally be printed, somewhat outdated and retrograde at the time of its publication, which coincides with the astronomical storming of the Bastille by Isaac Newton.

But the avatars of the publication should not lead us to classify David Gans among the members of the "old regime." He is, before Delmedigo, who precedes him by a good thirty years, the author of a thrilling manuscript about the shock provoked in the soul of a Jew by his encounter with Tycho Brahe and Johannes Kepler. I had the satisfaction of having printed, a year before his death, in 1612, in his Magen David, the first enthusiastic mention of Copernicus. David Gans is indeed the Jewish pioneer of the astronomical revolution.

It should be noted, however, that even though David Gans never personally knew either Tycho Brahe or Johannes Kepler, he was nonetheless equipped to engage with their theories on an intellectual level. His personal training, indeed, his researcher temperament, and his attendance at the Schools of Rema and Maharal endowed him with three characteristic qualities that could make him, if not a disciple, at least a keen observer of the new astronomy: a positive attitude towards the sciences, freedom of thought, and fidelity to tradition. Three qualities involving the risks of contradictions and serious conflicts, But we can never say often enough that the astronomical revolution made its way through an enormous accumulation of paradoxes. David Gans stepped in and embarked on this path with that mix of naivety and courage that we find in him at every crossroads of his journey.

THE EPILOGUE OF NEHMAD VENAIM.

It is in the epilogue of *Nehmad Venaim* that the dominant themes we have just listed are vividly illuminated. A positive attitude towards the sciences allows David Gans to rediscover his flair as

a historian and to paint a vivid picture of the history of astronomy from its origins up to 1600. David Gans claims freedom of thought in a conclusion that is both apologetic and polemical, in which one can feel the direct influence of his two Jewish Masters, the Rema and the Maharal.

Loyalty to tradition, ultimately, must be understood in its broadest sense, one that even leads loyalty to clash with freedom, creating the conflict that runs throughout the entirety of the human experience in the sixteenth century. David Gans does not shy away from the risks of internal strife, and in the epilogue, he provides a characteristically Jewish description that allows us to better situate, within the entirety of the 16th century, the specifically Jewish aspect of the spiritual drama in which almost all the great geniuses were more than mere spectators: they were actors and, often, victims.

DAVID GANS, HISTORIAN OF ASTRONOMY.

The history of astronomy occupies I have two-thirds of the epilogue of *Nehmad Venaim*. It also contains an element of apology, or rather, the purely historical narrative will constantly be accompanied by an apologetic thread, which does not detract from the interest of these pages, which are also, one can feel it very strongly, immersed in the atmosphere in which David Gans's life unfolded at the time he was writing them. It is less about displaying erudition than about projecting, in a book, an existential experience.

Let us not forget, first of all, that Gans was a historian by temperament. Better than his predecessors, many of whom had already sketched a historical outline of Jewish astronomy, he knows how to enrich his presentation with original details, but above all, he broadens the horizon and presents, in his retrospective, a comprehensive view that encompasses both Jewish astronomy and non-Jewish astronomy. To this horizontal universalism corresponds a vertical universalism; David Gans indeed traces the history of astronomy from the first man, Adam, and leads it up to Nicolaus Copernicus, and then to Tycho Brahe and his team, of which David Gans himself is a part. What are the main drivers of this evolution over five millennia and three and a half centuries? As in his column Zemah David, Gans first discusses Jewish relays, then non-Jewish relays.

THE HISTORY OF JEWISH ASTRONOMY

On the Jewish side: the patriarch Abraham, first of all, and the "scholars" of biblical times: David, the Tribe of Issachar, and especially Solomon, whose works extend beyond the biblical canon into apocryphal literature. To emphasize the importance and authenticity of the Wisdom of Solomon, Gans cites the testimony of Nahmanides in his Introduction to the Commentary on Genesis. UH could have cited his contemporary, Azarya dei Rossi, in the book Meor Enayim, which includes a rehabilitation of Alexandrian Jewish literature as a whole.

Then, the numerous Masters of the Talmud and the Midrash, true astronomers, worthy of the name by their scholarship, their vast knowledge in related sciences, mathematics, geography, geology, astrology. The list could have been long. David Gans is satisfied with a few prominent names; Rabbi Eliezer ben Hyrcanus, the author of the Pirké de Rabbi Eliezer, is rich in

astrological and astronomical remarks. Rabban Gamliel, famous for the arithmetic and geometric "tables" that allowed him to confront empirical observations with abstract mathematics; Rabbi Eliezer ben Hisda and Rabbi Yohanan ben Goudgada, kinds of encyclopedic geniuses, to whom none of the secrets of the most diverse sciences were foreign; Mar Samuel, who could boast that the roads of heaven were as familiar to him as the streets of Nehardea, where he led the Academy, which earned him a place in history under the name of Samuel the Lunar. Finally, Rav Adda, whose calculations and computations laid the permanent foundations of the Jewish calendar that has garnered the admiration of scholars worldwide, from ancient times—see the testimony of Hipparchus—up to contemporary astronomers. Let us not forget that Gans is writing his book barely fifteen years after the Gregorian calendar reform, while the Jewish calendar has required no adjustments, however minor, and has not been subject to any errors since it was established by the Master Astronomers of the Talmud, of whom Gans has just provided a brief overview.

Then come the Jewish geniuses of the Middle Ages and the contemporaries of David Gans, who were his immediate masters. Their list interrupts, it is true, the serene statement of the historical chain, for the names mentioned by David Gans are here. Regarding the painful problem of the glaring contradiction between Talmudic Jewish astronomy and Aristotelian astronomy, which was universally adopted in the Middle Ages by both Jews and Gentiles.

We will obviously return to this problem, which all the Jewish scholars mentioned by David Gans had to grapple with, in this section that should be regarded as a sort of methodological parenthesis. We will see under what specific circumstances David Gans himself was confronted head-on with the impact of this debate. Let us content ourselves for now with copying the list of Jewish astronomers mentioned by Gans in this parenthesis, who, since the Talmudic era, have contributed their brilliant knowledge to the history of astronomy: the great Maimonides, first of all, whose chapter dedicated to the rules for fixing the calendar in his code, the Mishné Torah, is teeming with astronomical data; Rabbi Abraham Ibn Ezra, the famous exegete and poet of the Spanish Golden Age, whom Gans acknowledges he has not read the works dedicated to the science of the stars; Rabbi Abraham bar Hiya, a great astronomer and astrologer, but also a distinguished geographer; Joseph Albo, Isaac Arama, philosophers like Maimonides and, like him, knowledgeable astronomers; Rabbi Isaac Israeli, the famous and brilliant author of *Yesod Olam* and *Shaar Hashamayien* (the former of these books is the "classic" of Jewish astronomical works from the Middle Ages); Zerahia Gerondi, whose *Sefer Hamaor* is also a classic worthy of being consulted alongside *Yesod Olam*. Then the great Gersonides (Ralbag, in the Jewish tradition), about whom David Gans adds an important remark: "The Ralbag distinguished himself in a remarkable manner in astronomical sciences in the first chapter of the fifth part of his work *The Wars of God*." Alas, the printer skipped this chapter on the pretext that it constituted a large book part. "I admit that I have not been able to become acquainted with them

until now, just as there undoubtedly exist many other Jewish authors besides those I have mentioned, but whose works I have not been able to consult." [6]

Finally, the two special mentions, already transcribed by us for the immediate Jewish masters of David Gans: the Rema of Krakow and the Maharal of Prague*.

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1. David Gans' remark is absolutely correct. *The Wars of God* by Gersonides were printed for the first time in 1560 in Riva di Trento. But the publisher, Jacob Mercarra, warns in the preface that he has reserved the first chapter of the fifth part, which constitutes a true treatise on astronomy, for a later edition, as it has no immediate connection with the two following chapters, in which Gersonides returns to the actual subject of his book: theology and religious philosophy.

Renan-Neubauer (*The French Jewish Writers of the 14th Century*, XXI, Paris, 1893, p. 586 sq) provide, based on manuscripts, a detailed description of the 136 chapters of this part omitted by the printer (see also: Joseph Carlebach: *Levi ben Gerson as a Mathematician*, Berlin 1910) and specify that the famous Latin translation of excerpts from *The Wars of Go*d, completed during Gersonides' lifetime. In 1342, at the request of Pope Clement VI, it actually constitutes "a pamphlet carved from the entirety of the fifth book" (p. 621). This "opuscle" contains a detailed description of the Jacob's Staff and the dark chamber invented by Gersonides. And it is this "opuscle" that must be acknowledged, alongside the printed book, in the frequent citations of Levi ben Gerson by Tycho Brahe (Opera Omnia, ed. Dreyer, 1929, I, IX, XXIV, V, 320, 322) and of Rabbi Levi by Kepler. (Optica, 214, 215). But in the often-cited correspondence between Johann Remus Quietanus from Rouffach and Kepler (Collected Works, ed. Caspar, vol. 18, Letters no. 1095 and 1103, letters written respectively in December 1628 and March 1629), what the two friends are seeking are precisely the purely astronomical developments (and not optical) omitted by the printer in 1560.

It is therefore incorrect to assert, as is often done vaguely, that Kepler tried in vain to obtain the works of Gersonides. Kepler had a very precise knowledge of the works of Gersonides that were available at the time, as well as of the existence of a fragment which he assumed must be known in Basel, Tübingen, or among Jewish circles through manuscripts.

But is this the only mistake made regarding Gersonides? This Jewish philosopher was in Bagnols in 1288 and lived in Avignon and Orange until 1344, suspected of having converted to Christianity. Due to the interest shown in his work by the Pope, confused by the virtue of the Latin transcription of his name Lévi (Leo) with Judah Messer Leon or with Leo Hebraeus of the sixteenth century, and by the grace of his father's name Gerson, with the Christian philosopher Jean Gerson (1363-1429), he has also seen his paternity of discoveries in the field of optics contested. (cf. supra, p. 161). Here are two recent quotes from authors whose scientific authority is too solid for it to be anything other than repetitions of stereotypical formulas, passed down through the ages:

"The sailors of the 15th century made use of the crossbow, or Jacob's staff, an instrument invented in the previous century by Leon the Jew, a Jewish inhabitant of Provence." "It is wrongly that, later, this invention was attributed to Regiomontanus" (E. Doublet: *Nautical astronomy and the great maritime discoveries of the 15th and 16th centuries*, in Scientia, Milan, October 1935, p. 216). Thank you, dear Doublet, for this accurate information. But in which encyclopedia can one find this "Léon the Jew, an Israelite living in Provence," who, under your pen, takes on the appearance of a very illustrious unknown, when in fact he is Lévi ben Gerson, to whom Renan-Neubauer dedicated a good twenty pages?

"As for the astrolabe, its invention is attributed to the Greek astronomer Hipparchus in the 2nd century BC." It had been replaced by the quadrant, which was an improvement but lacked precision, because the plumb line, which served as its line of faith, swayed according to the movements of the ship. To address this inconvenience, navigators had adopted the marine crossbow, also known as the balestrille or Jacob's staff, whose refinement is attributed to the German astronomer Johannes Regiomontanus, known in scholarly circles as Regiomontanus, around 1531. (Jean Babelon: *The America of the Conquistadors*, Paris, 1947, p. 68-69). I hope that the date of 153] for Regiomontanus is a typo (see below, p. 335). But why mention the name of the German astronomer who is said to have perfected the Jacob's staff and remain silent about the Jewish astronomer who, by all accounts, invented it?

It is also difficult to understand why Pierre Duhem (The System of the World, Paris, 1913, V, p. 201-213 and IX, p. 325 sq) insists on demonstrating that in his intuitions about the rotation of the Earth, Gersonides was certainly influenced by the University of Paris, while these "intuitions" were already diffuse in the Zohar (cf. above, p. 157) and that the same Duhem does not hesitate to qualify Nicolas of Oresme as the "French precursor of Copernicus" without considering for a moment that this said Christian Frenchman (1320-1381) could have been influenced, in turn, by the Jewish Frenchman Gersonides. (1288-1344).

Finally, it is in vain that Baruk Rafaél Goldstein (The Commentary of the Ralbag on Astronomy, Proceedings of the Israel National Academy of Sciences, IV, Jerusalem, 1971, pp. 174-185) embarked on the search, in the manuscripts, for the 136 astronomical chapters of Gersonides that David Gans points out. The omission in the printed first edition that Kepler was trying to obtain. Indeed, Goldstein did not consult the Turin manuscript. Or, Charlie Touati (Lévi ben Gershom: The Wars of the Lord, Paris, 1963) points out (p. 34) that this manuscript from Turin, the only one among the six manuscripts in the Renan-Neubauer list that included these astronomical chapters, was lost in a fire back in 1904! Goldstein will therefore have no more chance of discovering the precious text than Kepler or David Gans did.

Incomplete list, as it should include names that appear in the body of David Gans' book, such as that of Judah Halevi in particular. The author did not find it necessary to insert them into the historical chain, which he is now pursuing by moving from the Jewish kingdom to the realm of the Gentiles.[7]

HISTORY OF NON-JEWISH ASTRONOMY.

The terms kingdom and domain, which we use even though they do not appear in the writings of David Gans himself, seem to accurately reflect the relationship established by our author between Jewish astronomy, on one hand, and non-Jewish astronomy, on the other. This one is just a province of that one.

Certainly, one cannot trace the origins of Jewish astronomy back further than Abraham, the father of the Jewish people, while non-Jewish astronomy has its roots in the ancestor of humanity, Adam. Only, if Adam was an eminent astronomer before there were any Jews in the world, he bequeathed all his science not to humanity, but to the first Jew, Abraham. It is from Abraham the Jew that successive and regular historical contacts will carry the astronomy of the Jewish kingdom to the non-Jewish provinces that will inherit it: first Egypt, then the Greeks, the Chaldeans, the Arabs, and finally, the Moderns.
It is here that, within the framework of the names of non-Jewish astronomers, David Gans introduces the theme of the Jewish origins of universal astronomy. For the clarity of the presentation, let us first follow the author in the narrative: we will then trace back to the Adamic and Abrahamic sources to uncover, along with Gans, their reverberations throughout history.

The palm goes to the Egyptians for three reasons, the first of which precisely relates to the intertwining of the history of the Jewish people with that of Egypt. But two other motivations played a role in making Egypt an autonomous and privileged province of astronomy. It is primarily the physical phenomenon of the regular floods of the Nile: it constituted, in a way, the economic reason for the Egyptians' invention of geometry, as surveying and the redistribution of land became necessary after each flood. From the measurement of the earth, the Egyptians moved on to the measurement of the sky, to the point that even today, astronomy is metaphorically referred to as "geometric," proof, if it were needed, of the genesis of the measurements of the sky, the planets, the zodiac, starting from the measurements of the earth. But the Bible itself (Deuteronomy 11:10) does it not attribute to Egypt the climatological privilege of being a country without rain, and therefore, without clouds? Nothing surprising, therefore, that it is in this country with its always clear skies that the first observations could be made with perseverance and method, leading to the development of this astronomical science, which is one of the most remarkable contributions of Egypt to universal wisdom.

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1. cont'd. Finally, it is in vain that Baruk Rafaél Goldstein (*The Commentary of the Ralbag on Astronomy, Proceedings of the Israel National Academy of Sciences,* IV, Jerusalem, 1971, pp. 174-185) embarked on the search, in the manuscripts, for the 136 astronomical chapters of Gersonides that David Gans points out. The omission in the printed first edition that Kepler was trying to obtain. Indeed, Goldstein did not consult the Turin manuscript. Or, Charlie Touati (Lévi ben Gershom: *The Wars of the Lord,* Paris, 1963) points out (p. 34) that this manuscript from Turin, the only one among the six manuscripts in the Renan-Neubauer list that included these astronomical chapters, was lost in a fire back in 1904! Goldstein will therefore have no more chance of discovering the precious text than Kepler or David Gans did.

They emigrated to Greece first, then to Chaldea. For these two regions, Gans's presentation will change its approach. It is no longer a chronological list of names, as before, but a division into two distinct groups of scholars: those whose works are lost and whose theories have only reached us through the other group, from which we still possess valuable books or manuscripts to this day.

The Chaldeans are categorized as a whole in the first group. Moreover, only two names are mentioned by Gans, those of Timocharis and Aristyllos, famous for being the pioneers of the study of fixed stars, but we only know them through what Hipparchus and Ptolemy say about them. For the Greeks, Gans classifies in the group of scholars whose works are lost, the pre-Athenians Kidon, a contemporary of the Trojan War, Siron, a contemporary of the prophet Daniel (in which Alter is right to recognize a corrupted form of Hesiod), and Thales of Miletus. Then, the eminent representatives of the glorious School of Athens: Solon, Pythagoras, and (questionable reading) Empedocles.

Following are the Greek authors whose works still constitute, at the present time, the foundational library of astronomical science. The succession is chronological and interspersed with chronological digressions as well, providing David Gans the opportunity to cite Jewish chroniclers such as Abraham Zacuto and his Sefer Yuhasin and the Meor Enayim of Azarya dei Rossi. But the enumeration is also hierarchical and presents, in three columns, an interesting summary of the evolution of astronomical themes in ancient Greece. At the base, Euclid; at the summit, Ptolemy.

Without being astronomical in the technical sense of the term, Euclidean geometry laid the foundations of astronomy. She is "the ladder that connects the earth to the sky." "Without the ladder anchored to the ground, we would not have been able to ascend to the sky." We previously mentioned the panegyric of Euclid by David Gans and recounted how his encounter as a teenager with Euclid's book was a true "love at first sight." Archimedes adds to Euclid the resources of empirical observation. In Syracuse, he had managed to build a model, made of transparent glass, of the celestial sphere, large enough for him to settle inside and conduct his calculations based on this miniature reproduction of the sky.

Aristarchus proposes the hypothesis of the movement of the Earth. The genius of Hipparchus eclipses that of all his predecessors, and his calculations of unmatched precision served as the foundation for Ptolemy's system, who acknowledges him as his master.

The genius of Hipparchus eclipses that of all his predecessors, and his calculations of unparalleled precision served as the foundation for Ptolemy's system, which acknowledges him as its Master.

A reference once again to Callippus and Sosigenes, who enabled Julius Caesar to establish the calendar that bears his name and which remained in use until the Gregorian reform experienced by David Gans himself.

Finally came Ptolemy.

To this genius who was able to synthesize all that had been contemplated, calculated, and written by his Egyptian, Chaldean, Greek, and — already — Christian predecessors, since he lived in Alexandria around the year 140 AD, to this luminary to whom we owe the masterwork of universal astronomy, the *Almagest*, David Gans dedicates not only a meticulous chronological study (which allows us to learn, in passing, that these lines are written by Gans in 1611) but also a true panegyric, all the more significant as it is borrowed, Gans says, "from the eminent scholar, Sir Tycho Brahe." The Romans undoubtedly conquered Alexandria. But their Empire has collapsed, while the Alexandrian Claude Ptolemy has conquered the Empire of Earth and that of Heaven in a lasting and eternal manner. His double Empire is still standing.

Moving on to the Middle Ages, the harvest seems quite meager, after the enumeration of the astronomers of Antiquity. Only two names are mentioned by David Gans: that of Albitini (Al-Battani), to whom Maimonides acknowledges his great debt, and that of King Alfonso of Spain and Sicily (Alfonso X), a renowned astronomer himself, who established, through a circle presided over by a Jewish Rabbi, Isaac Ibn-Sid, the famous Alphonsine Tables, of which David Gans, precisely, translated a copy from Hebrew into German at the request of Sir Tycho Brahe. It's little for the entirety of the Middle Ages. But, in fact, who could still "invent" anything in astronomy, who could advance it after the great Ptolemy?

FIRST MENTION OF COPERNICUS IN A HEBREW TEXT.

Here, abruptly, is yet another notice dedicated to a 16th-century astronomer: Nicolaus Copernicus. Why him? Because, according to the unanimous opinion of contemporary astronomers of David Gans, at the end of the 16th century, no one, since Ptolemy, had equaled in science the Alexandrian leader, except precisely the Prussian Nicolaus Copernicus. Let's listen to David Gans:

"Nicolas Copernicus, a Prussian, is the most famous and remarkable astronomer among his contemporaries." The scholars of our time are unanimous in attesting to his genius, the depth of his knowledge in astronomy. They say of him that he has not had his equal since Ptolemy. His extensive knowledge and sharp intelligence led him to attempt to prove that the Earth rotates continuously around itself. Let us note that the assertion is not new. It has already taken root in the minds of men who preceded us two millennia ago. I indeed found in the book "Of Heaven and Earth," in the second chapter of the fourth part, that such was the opinion of the famous scholar Pythagoras and his followers! On this theme, Copernicus composed an admirable, systematic, and extremely profound book. This book was completed in the year 1500 of the non-Jewish era, which is the year 5098 of the Jewish era. This illustrious scholar died in his native province, Prussia, in the year 1543, which corresponds to the year 5303 of our era. Does the history of astronomy come to an end for Gans with Copernicus? Apparently, since the epilogue is now brief and shifts from storytelling to justification. Two pages are dedicated by Gans. 4 the illustration and 4 the defense of astronomy against its detractors within the Synagogue. "We will analyze them further on."

Only, there is still, as we said, right at the end of the epilogue, reserved for the grand finale, this "conclusion of conclusions," this final seal with which David Gans concludes both the epilogue and the entirety of his Nehrnad Venaim.

This conclusion, as we have also mentioned, is, through the evocation of the hours spent with him at the Benatek observatory, and also through the presentation of his system, the most moving and profound tribute that David Gans could pay to the one whom he undoubtedly regarded as the sovereign genius of astronomy, the only one who not only reached Ptolemy, as Nicolas Copernicus had done, but who also knew how to surpass him: Tycho Brahe.
It is Tycho Brahe's system that represents for David Gans the final point in the evolution of astronomy. Through history from Adam to the beginning of the 16th century, up to the years 1611-1613 when he completed the manuscript of his *Nehmad Venaim*.

THE JEWISH IMPACT ON NON-JUDEO-CHRISTIAN ASTRONOMY.

However, as we have indicated, there is a complete framework that connects this chain from Adam to Tycho Brahe: it is the framework of the Jewish impact on non-Jewish astronomy. The apology regains its sovereign rights here. She appears from Adam, who bequeathed the entirety of his universal knowledge to the first Jew, Abraham.

We find it again in each of the great windows of "universal history of astronomy." Egypt? Would she have ultimately acquired astronomical hegemony if the Jewish people had not longed for it for centuries?

However, as we have indicated, there is a complete framework that connects this chain from Adam to Tycho Brahe: it is the framework of the Jewish impact on non-Jewish astronomy. The apology regains its sovereign rights here. She appears from Adam, who bequeathed the entirety of his universal knowledge to the first Jew, Abraham.

We find it again in each of the great windows of "universal history of astronomy." Egypt? Would she have ultimately acquired astronomical hegemony if the Jewish people had not longed for it for centuries? The climate of Egypt alone is not sufficient to explain the dominant place occupied by astronomy in this country. It is the children of Abraham, Isaac, and Jacob who, during their stay in Egypt, irrigated the land with the knowledge they inherited from the Patriarchs. The Chaldeans?

But the Jews were they not in constant contact with Chaldea and did they not experience a second Exile there, after the first in Egypt? The Greeks, the Athenians? These are the first four to recognize — read the books of Pythagoras or Hipparchus — how much they owe to the Jews. As for the great Ptolemy, how could he have drawn his knowledge from the famous library of Alexandria if it had not been nourished, enriched, and brought to the height of its prestige by the Alexandrian Jews?

Are we to claim, as Maimonides does, that since Ptolemy, knowledge has changed sides, that the tribulations of the Exile have caused the Jewish people to forget the real foundations of astronomy, and that since then, it has become the domain of the Gentiles?
If David Gans poses the question, it is to better prepare the explosive "no" that he will wield against the defeatist thesis of Maimonides as taken up by the Rema. With a deep and insistent conviction, David Gans will repeat that not only the non-Jewish astronomers of the Middle Ages

but also, and especially, the contemporaries, the universal geniuses of the 16th century, such as Copernicus and Tycho Brahe, have, like Ptolemy and Pythagoras before them, acquired their knowledge thanks to the Jews.
However, David Gans does not present this conviction based on unfounded hypotheses or purely abstract reflections. He draws it, gripping, exhilarating, victorious, from the concrete struggle he has the exceptional privilege of engaging in with these giants; he draws it even from that dazzling experience at the castle of Benatek, in the observatory of Tycho Brahe, which he makes, for reasons we now understand in all their depth, the conclusion of conclusions of his book.

But before reaching this conclusion, David Gans had to navigate through the difficult problem raised in what we have called the methodological parenthesis of the epilogue. A parenthesis that David Gans cannot and does not want to avoid opening wide, because from his Jewish masters he has inherited, as we indicated at the beginning of this chapter, and it has been the taste of history and sciences, two other dispositions of mind, which David Gans cannot and does not want to escape, although they appear at first glance to be contradictory: freedom of thought and fidelity to tradition.

THE FREEDOM OF THOUGHT OF DAVID GANS,

Freedom of thought: In the 15th century, as in the Middle Ages, these three words did not refer to the spiritual atmosphere in which the overwhelming majority of Western humanity evolved. What remained, on the contrary, was the privilege of a few courageous individuals, some of whom had to pay the price on the stakes, with the difference that they were no longer incited solely by the Catholic Church but also by the Reformed branch of the Church. Consider the martyrdom of Michel Servet in Geneva, condemned to be burned alive by Calvin in 1553, just as Étienne Dolet was in Paris by François I in 1546, and Giordano Bruno in Rome by the Pope in the year of grace 1600.

Neither the Renaissance, nor Humanism, nor the Reformation had managed to transform the majority and massive part of human society, which remained subjected to the narrow-minded fanaticism of obscurantism, dogmatism, and witch hunts. We have just reminded ourselves: one of the most tragic phases of the last few lamentable years of Jean Kepler's life will consist of an abominable witch trial brought against his mother by the Lutheran Church. A few years later, the threats of torture were wielded by the Catholic Inquisition against Galileo. It is all the more remarkable that the Jewish community stands out in this context. Undoubtedly, there has never been any question of excessive fanaticism leading to torture or execution for the crime of opinion. However, Jacob Katz has traced the history of the ongoing and fierce struggle waged by the majority of the Jewish community against a minority of fanatics. Obscurantism certainly had its followers among the Jews in the 14th century, but the entire Jewish community, guided by its great Masters, opened itself to the light, to the new brilliance of the Enlightenment, with a passionate desire to be deeply infused by it.

Apology of Astronomy. In the specific case of the study of astronomy and, more generally, of secular sciences, David Gans merely allowed himself to be carried along by a movement whose rhythm was orchestrated by past and contemporary Jewish masters. He also hears the grumbling and complaints of certain Rabbis who lament about "the lost time" spent on "these trivialities,"

while the true task of the Jew awaits him in the infinite and complex realm of Talmudic casuistry, which alone can dictate his duties and conduct. But, like Maimonides, and more closely to him, his immediate masters, the Rema and the Maharal, David Gans knows that these Rabbis are merely powerless dwarfs, who use halakha as an easy and practical means to secure a good place in the world to come. Hats off to the halakha! Yes, without her, there is no Judaism, no Jews! But study, like observance, must be selfless. It is not by squinting at the reward that the Jew must live, but by fulfilling his duty because that is the duty. But isn't astronomy a fundamental duty, a mitzvah, without which a Jew could not establish the calendar of his religious life? You object to me that this calendar has been definitively set for centuries, and a small pocket louah is enough to navigate the Jewish year, without the need to waste time studying astronomy. It is to misunderstand, repeats David Gans after Isaac Israeli and Maimonides, the very meaning of the Jewish calendar, whose fixity should not obscure the complex and dynamic implications, without the knowledge of which the consequences of mitzvot could not be fulfilled. It is not through a mere play on words that the Sages of the Talmud speak of the mystery of the Jewish calendar. This mystery is precisely the entirety of its astronomical content, eternally alive through the ages, and to which, of course, one cannot access without the ladder (the image is from Maharal and also from Mordecai Jaffe) of the ancillary sciences of astronomy, namely mathematics, geometry, and geography.

But there is in the Jewish apology for astronomy a pleasure that David Gans expresses with the vibrant enthusiasm that seizes him whenever the opportunity arises to recall it. Even if astronomy were not one of the cornerstones of the edifice of Jewish halakha, one should still devote oneself to it body and soul, for it is through it that the greatness of the Divine work is revealed. Reminding us of the comments by David Qimhi and Joseph Albo on Psalm 19, David Gans, in a burst of Keplerian and Pascalian style, as well as Maimonidean and Maharalian, places the reader before the heavens that proclaim Divine glory and the work of His Hands. Where then can man gather the silent echo of the Creator's Voice if not in the contemplation of the stars and their marvelous movements? Mystical lyricism?

Certainly, but also a source of rational knowledge. For these wonderful movements are so contradictory that, by their very contradiction, their mysterious antagonisms, they call for the necessity of a Creator. Astronomy thus becomes the foundation of faith. And, through a literary irony that once again highlights David Gans's freedom of thought, at the very moment when the mention of the theme of contradiction could have led him to rely on some quotation from the Maharal, he seeks companionship from the quintessential antagonist of the Maharal, Rabbi Eliezer Ashkenazi, whose "admirable exegesis" (in Maasé Hashem, ch. 21) of the verse: "You shall know the Eternal, your God" he quotes at length. Since the Torah does not say "You shall believe in the Eternal, your God," but rather "You shall know Him," this clearly proves that true faith can only be founded on knowledge, a theme that Maimonides had already extensively developed, but which David Gans draws here from Eliezer Ashkenazi, as if he wanted to unite in the same tribute the passionate mysticism of his Master, the Maharal, and the rigorous rationalism of Eliezer Ashkenazi, who, during their lifetimes, would insult each other in a controversy that David Gans would like to transcend here in a fruitful synthesis. Small lesson, well deserved by the way, given by the disciple to his Master.

Finally, the last apologetic argument in favor of the study of astronomy by Jews: the opinion of non-Jews. Here we enter the moment experienced by David Gans himself. It is no longer the representative of a traditional lineage who speaks, but a man who, in Prague, in the year 1600, knows that he is entrusted with a responsibility in the most literal and immediate sense of the term: he must be able to answer the questions posed to him, particularly about the Jewish calendar, and about everything related to this vast domain, by the non-Jewish astronomers who have called upon him to collaborate on their work at the castle of Benatek. Not being able to respond, to take on this responsibility, here and now, remaining silent in the face of this onslaught of questions, would that honor our name as Jews, would that honor Him who, in creating us all, bestowed upon us this additional dignity of a Torah whose purpose is to be "our wisdom and our understanding in the eyes of the nations"?

THE METHODOLOGICAL PARENTHESIS OF NEHMAD VENAIM: THE ISSUE IS NOT THE AUTHORITY OF THE BIBLE, BUT THE AUTHORITY OF THE TALMUD.

Fidelity. By "faithfulness," we mean the religious tradition, belief in God in the broadest and most lyrical sense of these terms, as they are constantly found in the writings of Brahe and even more so of [Kepler], but also, in a more restricted sense, as we find it in Brahe, Kepler, and Galileo, faithfulness to the biblical tradition. But for David Gans, because he was Jewish, this fidelity to the biblical tradition must be linked to fidelity to the rabbinic tradition, the latter carrying more weight than the former. This remark, going beyond the specific case of David Gans, sheds light on an often overlooked aspect: an important difference between the Jewish attitude and the Christian attitude in the face of the astronomical revolution in the 16th and 17th centuries. Let us note it down so as never to forget during this study: the scandal caused by Copernicus, which would ultimately lead his book, as well as the very people of the Protestant side and Galileo (from the Catholic side), to the index, excommunication, and retraction, is provoked, in the Christian conscience, by the clash between the new astronomy and the Holy Scripture, the Bible, whether it concerns (which is the most frequent case) the Old Testament (the account of Genesis, Joshua, the Psalms, Job) or the New Testament (the Gospel according to Saint John and Revelation). On the contrary, Jewish consciousness, as much as it was scandalized by Copernicus (though the term is too strong; it should be scaled down to its actual proportions and rather said: as much as it was astonished and surprised by Copernicus), rarely reacted by referencing Scripture.

Certainly, among Jewish authors, one can find a record of astronomical-biblical antinomies, and David Gans, in particular, elaborates quite extensively in chapter 64 of *Nehmad Venaim* on the possibility of reconciling certain verses from Genesis and the Psalms with the new thesis, which he considers undeniable, regarding the existence of antipodes. These verses were used, in the Middle Ages, by Abraham [bn-Ezra, David Qimri, but also by astronomers as competent as Maimonides, Abraham bar Hiyya, and Isaac Israeli, and even by "enlightened" contemporaries such as Azarya dei Rossi, to justify the old Ptolemaic hypothesis of a land whose lower half would be submerged in waters. Moreover, the broader and more complex issue of "upper waters" and "lower waters," through which Genesis begins the account of the creation of the earth, is also mentioned by David Gans in the following chapter. (65). But these antinomies are only apparent, as Jewish biblical exegesis is flexible enough and versatile to allow the verses to be interpreted in perfect harmony with the new theses that experience renders irrefutable. The "oceans" with

which, according to Psalm 24 (verse 2), the Creator founded the earth are not the cosmic waters, but simply, as the end of the verse specifies, the seas and the rivers. Regarding the "votite" of the second day of Creation (Genesis I, 6), it refers, in a first stage, to the "interior waters" and the earth, and no longer directly to the cosmic waters of the universe. Let us note, in passing, that once again, David Gans resorts here to an exegesis by Eliezer Ashkenazi, the quintessential anti-Maharal. But all of this is very secondary and, in essence, is merely a problem of exegesis, internal to Judaism. Chapter 65 concludes with the modest assertion of a David Gans, who claims to maintain his exegetical hypotheses only as long as he has not gathered better ones from the mouths of his Masters. In any case, Gans is deeply convinced that the biblical text does not hinder new astronomy. "Never does he contemplate the dreaded moment by Kepler, when one would have to choose between Writing and Truth."

On the other hand, what he fears is the necessity of a choice between Truth and the Talmud. For the Talmud, this oral Bible of the Jews, is filled with texts that are so aberrant in relation to new astronomy that this is where the true obstacle lies, forcing the Jew into the difficult and painful necessity of confronting it, under the threat of being unfaithful to what constitutes the very backbone and the perpetually living spirit of Jewish tradition. It is the Talmud that holds authority within the Synagogue. It is through him, and him alone, that the Bible is read, interpreted, and accepted by the Jews of the Middle Ages and the 16th century, spiritual and natural heirs of the Pharisees. Or, it is here that the use of the word scandal can be justified, and where its limits lie. Regarding the Jewish reaction (although this obviously never led to any form of indexing or "excommunication"), the contradiction between what can be called Talmudic astronomy and Copernican astronomy was by no means a new fact, as a similar, if not worse, contradiction had been noted by Jewish scholars of the Middle Ages, with the great Maimonides at the forefront, between Talmudic astronomy and the Ptolemaic system! The scandal, for centuries, was permanent, between "Jewish" astronomy and "non-Jewish" astronomy, the latter being accepted as "true" due to the combined virtue of reason, Aristotle, and Ptolemy. The problem was to find a method capable of saving, if not the "truth," at least its honor.

Such is the problem. And, in chapter 64, David Gans announces that he will dedicate "a small note" to it in the conclusion of the book—this small note which we prefer to call a methodological aside, as it indeed concerns the elucidation of a method of fidelity that is the subject of this note. We will read this methodological parenthesis by placing it within the broad field of debate that has animated Jewish thought for centuries, and as it had recently taken on one of its sharpest forms for David Gans. Briefly revisiting the history of the debate, David Gans reminds us that within the Jewish tradition there are two extreme options, above which some are trying to build a bridge of cautious and moderate reconciliation.

DAVID GANS BETWEEN THE RATIONALISM OF MAIMONIDES AND THE META-ASTRONOMY OF THE MAHARAL.

At one of the extreme positions, that of Moses Maimonides, nuanced a century later by Isaac Arama. She decisively cuts through the debate in favor of science and boldly claims that in the time of the Talmud, Jewish scholars neither had a comprehensive view nor a collection of details that could align their own knowledge with that of their non-Jewish contemporaries in astronomy.

In this field of astronomy, as in that of medicine and, in general, the exact sciences, the Sages of the Talmud never claimed to possess a revealed truth, a tradition, kabbalah, that dates back to Sinai. They cut according to their autonomous and subjective knowledge, which varies with time and space, personality and society, and their "doctrine" lacks the criterion of heteronomy that must be applied to everything concerning, in the Talmud, the realm of the commandments revealed at Sinai and transmitted flawlessly from generation to generation. Moreover, Isaac Arama adds to Maimonides' thesis, why would the Rabbis have wasted their time and focused on the purely scientific aspects of astronomy? What interested them — and concerned them — were precisely the revealed commandments, the mitzvot of the Torah, and astronomy was, for them, merely a servant, an ancillary resource, which they needed for the establishment of the religious calendar.

Paradoxically, this position found a solid reference in the Talmud itself. Indeed, in the Pesahim 94b treatise, the Sages of Israel acknowledged, regarding an important astronomical issue, that their thesis was incorrect and that non-Jewish astronomers were right. This ingenuous yet crucial confession, placed in the mouth of one of the highest authorities of the Talmudic era, Rabbi Judah the Saint, to whom Jewish tradition owes the Mishnah, was obviously sufficient evidence to establish this enlightening opinion, if he indeed made it.[8]

On the other extreme, there is the position of the Maharal, which is also illuminated; but instead of being illuminated by reason, it is illuminated by Kabbalah. For the Maharal, indeed, the mistake lies in treating the Masters of the Talmud as scholars in the Aristotelian sense of the term. Certainly, they possessed enormous knowledge in medicine or astronomy, but none of them was a doctor or an astronomer. Certainly, they have discussed medicine or astronomy at length, but neither their objective nor their language was of a medical or astronomical nature. Behind the phenomena, it is the essence they wanted — and knew — to reach. And it is the essence they speak of, and not appearances. When a contradiction appears between the astronomy of the Talmud and that of Ptolemy, it is not due to the ignorance of the Rabbis in astronomical matters, nor to any disdain for this respectable science in itself. The contradiction has deeper roots; it derives from the irreducible opposition between philosophical thinkers who discuss phenomena and mystical thinkers who delve into essences. "The confession" of Rabbi in the page of the Treatise. Pesahim is neither an admission of deficiency nor an admission of ignorance, but rather the very sign of an irreconcilable quarrel between men who see the world as it actually presents itself to the senses and other men, willing to readily acknowledge that on this physical level their partners are right, but that, nevertheless, the truth is on their side because projected onto the metaphysical screen, the image of the world is suddenly reversed. Olam hafuk: the upside-down world, — this favorite expression of the Maharal, and crucial for understanding his thought — applies to this problem of the astronomical as it is presented everywhere in his approach, close to the Philo-like and Neoplatonic allegory, nourished by Kabbalah, but tolerant of others just as much as Maimonides' illuminating option.

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[8] "Do not be offended that Aristotle's opinion here opposes that of the Doctors; for this opinion, namely that the stars have sounds, merely follows the belief (which holds) that 'the sphere remains fixed and the stars revolve.'" But you know that in these astronomical subjects, they acknowledge the opinion of the sages of the nations of the world as having precedence over their own; thus they clearly state: "And the sages of the nations of the world prevailed." And this is true; for all those who have spoken on these speculative matters have only done so based on the conclusions to which speculation has led them; that is why one must believe what has been established by demonstration. (Maimonides, *Guide*, IT, 8).

If David Gans had followed Maimonides' option, he would probably have arrived, by the end of the 16th century, when Enlightenment easily turned into skepticism, or even into the dogmatism of doubt, at the position of his contemporary Azarya de Rossi. Like him, he would have heavily insisted on the determinism of the time and space in which the Rabbis of the Talmudic era were mired, unaware of the discoveries and scientific advancements made over the past thousand years. Like him, he is laid bare, without raising an alarm, the historical or scientific errors propagated by Jewish tradition, applying a critical method to biblical or Talmudic texts, which, however, lacks, to be captivating, the grand effort of struggle. Azarya dei Rossi never gives the impression of living an inner struggle: he engages in skirmishes or controversies with texts or authors, but he does not resonate with that intimate and heartbreaking passion that one feels in a David Gans. The method of Azarya dei Rossi does not bite, at any moment, on the real astronomical problems, as they excited the passionate curiosity of David Gans. Azarya did not mention any of the "new" astronomers that he could have known chronologically. In his book, which is teeming with names of modern authors, one does not find either Copernicus or Tycho Brahe. Undoubtedly because nothing could seem "revolutionary" to Azarya dei Rossi, for whom everything was a permanent evolution or rather a puzzle of perpetual but microscopic movements. For Azarya dei Rossi, astronomy was like observing a barber's jar, while for David Gans, it was, as it was for his Masters, the exploration of the Divine Universe. A hypothesis like that of Copernicus could have momentarily disturbed the object placed on Azarya dei Rossi's work table, forcing him to readjust his glasses, while in David Gans it touched the depths of the soul, compelling a heartbreaking revision of his condition as a creature in the presence of the Creator.

It is precisely the method of this heart-wrenching revision, in the literal sense of the epithet, that David Gans could have learned from the Maharal of Prague. But how many times must it be said, the Maharal is isolated, like a rock, and his disciples could only admire from below the dizzying leap of his thought, unable to follow it. That the truth can only spring from within the very contradiction, that certainty can only be gathered from within, from the tear, that the void in the middle, the sacred space separating the finger of God from that of man, are essential for the existence of God as God and of man as man—these are propositions that only Michelangelo, Maharal, Isaac Luria, and Jakob Boehme could embrace in all the breadth of their challenges. Kepler had the intuition as well, and the study of his theology, which remains to be done, along with the surprising yet admirable place occupied by mysticism at the very heart of his astronomical system, allows us to suppose that the fascination exerted by Kepler on David Gans was of the same nature as that which the Maharal had on him: that of a genius who resolves the paradoxical mystery of the Freedom of man as a subject of God. We will see, in the conclusion of our study, that David Gans will also attempt to express this mystery, joining the grand astronomical fresco created by the Maharal in his Beer Haggola. But for now, we are not yet at the conclusions. It's a matter of choosing a method. Or, as much as David Gans decides to escape the illuminating seductions of Maimonides and Azarya dei Rossi, he also refrains from entering the methodological system of the Maharal.

However, the temptation is great to follow the Master, since (to our knowledge, at least) the Maharal of Prague is the first Hebrew author to allude to Copernicus. Faithful to the old rule of discretion to which most Jewish authors of the Middle Ages and the Renaissance adhered, the

Maharal does not explicitly name Nicolaus Copernicus, but the reference (*Netivot Olam*, *Netivot HaTorah* 25c) is too conspicuous to mislead the reader. However, this reference to Copernicus is inserted by the Maharal within the framework of his entire criterion system, which we recall here consists of four main characteristics.

It rests on the difference between science (*hokma*) and the Torah, one of those dialectical pairs on which the Maharal establishes the unstable balance of truth. The domain of the Torah is vertical. The one of the *hokma* is horizontal. It's the basic theorem without which! The interrelation of the two sciences cannot be understood. Everything that the Torah speaks of is metaphysical, and the way it speaks of it is also metaphysical. Everything that the *hokma* bets on, on the contrary, is physical, and the way it speaks about it is also physical. The wisdom only sees phenomena, while the Torah concerns the essence of things, the noumena.

The contradictions highlighted by a Maimonides or an Azarya de Rossi between biblical or Talmudic texts, on one hand, and scientific data, on the other, are therefore inherent to the very nature of the two "parts," which constitute the two dialectical sides of a single and the same truth. To want to overcome these contradictions through concordist exegeses is to misunderstand, fundamentally, the nature of this contradiction which is necessary in the order of things. To disdain science and elevate the Torah to the status of an absolute scientific principle is to demonstrate childish obscurantism: science is true, but the Torah is not a science. Conversely, rejecting the assertions of the Torah, as Azarya does, on the grounds that they are incompatible with science, demonstrates ignorance about the nature of the Torah, which is not a competitor of science, but a source of knowledge of a different kind.[9]

What is true for medicine, highly valued by Maimonides — and rightly so — is applicable to astronomy. Medicine is a venerable science. And astronomy as well. But they only talk about the physical causes of phenomena, causes that are real, but incomplete. The spokespeople of the Torah, the Sages of Israel, are well aware of this physical causality, but they do not speak of it.

They leave the exploration to the spokespeople of *hokma*, to the Sages among the Nations. What the Sages of Israel speak of are the metaphysical causes, the Divine causality, intertwined with physical causality. Justice is thus rendered jointly to Jewish astronomy and non-Jewish astronomy. Doesn't the law require a Jew to pronounce a blessing celebrating the Wisdom of the Creator when he sees a non-Jewish scholar just as much as when he sees a Jewish scholar? Only,

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[9] Let us highlight the remarkable similarity between this methodological position of the Maharal and that of Galileo in his famous letter to Christine of Lorraine (Opere di Galileo Galilei, National Edition, V, 1890, pp. 207-248). This letter is from 1615 (the condemnation of Copernicus's book will be pronounced by the Holy Office the following year). Galileo tried to justify his Copernicanism by taking refuge behind the distinction between the metaphysical domain of the Holy Scriptures and the purely physical domain of astronomy. The methodological text of the Maharal was published in his Netivot Olam as early as 1595:

"What, then, is the privilege of Israel in the field of astronomy? In this regard, it is perfectly true that the Gentiles have become passionate about this science and have reached absolutely exceptional levels of knowledge, sometimes, as everyone knows, giving the appearance of absolute and definitive understanding. Or, constantly, new scholars emerge among them who abolish the magnificent results that had been achieved with great difficulty. An example: just recently, a scholar has emerged who is called the inventor of 'new astronomy.' His system is entirely new, indeed, in the sense that everything his predecessors had established regarding the system of stellar orbits, the movement of planets, and other celestial bodies, he has completely overturned, drawing a wholly new scientific picture. He does, however, specify that he is not able to provide a system explaining everything.

in front of the representative of the Aokrra, the Jew thanks God for granting Wisdom to man. In front of the representative of the Torah, God is thanked for connecting certain men to make them His portion. It is this "Divine part" that, within or beyond the "human part," is explored by Jewish astronomy.

The Maharal outlines a sketch in the 6th well of Beer Haggola. The so-called "concessions" made by the Sages of Israel to the Sages among the Nations are by no means admissions of ignorance or deficiency. They delineate, on the contrary, the horizontal domain, "the lower world," according to the expression drawn by the Maharal from Kabbalistic terminology, a domain in which man is sovereign, central, situated in the middle, exposed to the interplay of physical causality and purpose. This field, Israel, while being familiar with it, willingly grants exploration to the inventive spirit of man. Within this domain that is uniquely its own, the human spirit evolves, discovers, and revolutionizes, without ever halting the cycle of this creativity.

It is at this precise moment in his reasoning that the Maharal of Prague — the first Hebrew author in history, let us repeat — evokes Nicolas Copernicus (in NO 24 c), but to insert him into the chain of this permanent relativity of astronomical science, thus paying tribute to the "revolution" achieved by this genius, while remaining in the serene anticipation of another and new "revolution" (Kepler, Newton, Einstein!!) that will replace his.This "explanation of everything," this key to the absolute, is possessed only by the Sages of Israel. Only, it does not open the world of phenomena, but that, unchanging, of noumena. Thus, in the end, for the Maharal, what one would call a "Jewish astronomy" is actually a meta-astronomy, a knowledge of the primary metaphysical causes and not a science of secondary physical phenomena. This distinctly scientific character, the Maharal only explicitly recognizes in non-Jewish astronomy, with the important nuance of a hint of relativity that undermines the massive Ptolemaic dogmatism, yet does not allow David Gans to use it as a sufficiently solid key to unlock the door behind which the truth he is seeking remains cloistered. This truth is not the metaphysical, transcendent truth, but the physical truth of the world of essences and appearances that he can and wants to grasp with his eyes turned towards the sky and diving into the infinite, not in a mystical dream but through the complex, yet concrete, solid, and tangible mechanisms of the instruments of an observatory.[10]

DAVID GANS AND THE CONCORDIST OPTION OF THE REMA.

Between the two extremes of Maimonides and the Maharal, here is a third option, the concordist option. She is ready to bow to the authority of the Sages of the Talmud, if proof can be provided that their scientific knowledge was revealed in the same way as their knowledge of the Torah. This is the thesis of the Rema, presented in the Torat Haola, which was published in 1570. David Gans is 29 years old. I was already in Prague when the work was published, two years before the death of its author. Let us imagine for a moment the young student, leafing through the thick

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[10] 1. We have not at all extrapolated the Maharal (as some have reproached us) by writing (after Kleinberger and Kariv, by the way) in our Well of Exile (p. 121) that the relativistic system of the Maharal "has a singularly Einsteinian aspect." His attitude & Copernicus's outlook announces what physicists will be compelled to adopt after Einstein. (See, for example: M. Born: The Theory of Relativity by Einstein, 1922, who writes (p. 251): "From Einstein's high vantage point, Ptolemy and Copernicus have equal rights: both perspectives yield the same laws of nature.") "The standpoint one chooses is not determined by principles, but rather by convenience."

volume in which his beloved Master, who had educated and raised him as if he were his own son, had laid out the findings of his astronomical research. The framework of the research is methodological, internal to Judaism; it concerns The problem that David Gans encounters on his path is the contradictions between certain statements of the Masters of Aggadah, in the Talmud and in the Midrashim, and the data established by non-Jewish science, contradictions that are particularly numerous, as emphasized by the Rema, in the field of astronomy.

We have seen how the Rema is a champion of reconciliation, and how he extends the concern for harmony to the broad conflict between philosophy and Kabbalah.[11] We will not be surprised to see him undertake, in the second chapter of the first part of his book, a series of attempts to show that Jewish rabbis and non-Jewish astronomers fundamentally agree on the essentials and that there is no error on either side. Frequent exercises under the pen of the Rabbis, sometimes high-flying, often artificial and forced, but which would nonetheless satisfy the curiosity of David Gans, if, as a conclusion and synthesis, the Rema, towards the end of this chapter, on folio 8 (a and b), did not suddenly call everything into question. David Gans learns, in fact, that at the present time, astronomy is divided into three major doctrines, each opposing the others. The first is that of the royal path of the *Almagest* by Ptolemy, on which non-Jewish scholars have built their monumental system that is still theirs to this day. It is she whom the Talmud commonly refers to with the expression "astronomical doctrine of the Sages among the peoples." It is based on the fundamental principle "of the movement of the spheres and the immobility of the stars."

The second is the doctrine of the "Sages of Israel," based on the inverse principle "of the movement of the stars and the immobility of the spheres," a principle that the Talmud itself asserts that the Sages of Israel did not adopt and "that they sided with the Sages among the nations." But do not understand by this, the Rema hastens to add, that the Talmud wants to suggest that the Jews have acknowledged being in error. What happened is that the tribulations of Exile made Jewish scholars forget the use of this principle as a key to astronomy and forced them to resort, as well, to Ptolemy's principle. But it's just a matter of method. The Jewish principle, opposed to that of Ptolemy, retains its stamp of truth in the absolute, and, as was the case in the past, it could serve as the basis for an astronomy different from that of Ptolemy, which one could properly call Jewish, in contrast to the non-Jewish astronomy of the *Almagest*, to which Jewish scholars have been compelled to conform, willingly or unwillingly, in a sort of historical accident. As for the third doctrine, it is that of the brilliant inventor whom the Rema names, after Isaac Israeli, Gersonides, Isaac Arama, and many others, Ish haraash, a man who brought a whirlwind into astronomy. It is about Al-Bitrogi (Alpétragius).[12] In his system, the spheres jostle at lightning-fast but uneven speeds, like horses on a racetrack. A phantasmagorical vision that an author as serious as Isaac Arama considers to be very plausible. What Al-Bitrogi lacked, according to Arama, was a sense of synthesis, or the time to achieve it; "If he had been able to complete his system, scholars, without exception, would have adopted it."

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[11] Above, p. 34.

[12] Recent edition by Bernard R. Goldstein, Yale University Press, 1971

Here is David Gans placed before three systems. Is it presumptuous to imagine that the young man would have loved to find in his Master's book the hint of a choice? David Gans must have known nothing about Copernicus in 1570, just like the Rema himself. But if among the three basic systems, one was defined as that of the Jewish tradition, wouldn't the Master have tilted the balance in his favor? Undoubtedly, this specifically Jewish system was, today — and for a long time — lost. But why assume that it would remain that way forever? Why not suggest that the Truth was included in this system and that it would burst forth again in broad daylight, blinding like the Messiah, hidden today — and for a long time — but that it would surely reveal itself one day? Why not link this certainty of the messianic coming to the certainty of what one could call an astronomical parousia, especially since the question was raised in a work dedicated to the messianic restoration of the Temple and its sacrifices? Or, here it is that instead of leading the disciple towards certainty, the Master was going to plunge him into the most painful of perplexities. Not only does the Rema not take a stance on the respective value of each of these three contradictory systems, not only does it dismiss any option in favor of one at the expense of the others, but in a cruel irony, it supports this categorical uncertainty with a text from rabbinic tradition, from a passage in the Midrash Béréshit Rabba (VI,13) where one of the most undisputed masters of Jewish thought, the very one revered as the author of the Zohar, Rabbi Shiméon Bar Yohai, declares: "We do not know if the spirits fly freely in the air, if they rub against the wall, or if they follow the natural laws that are their own." "The problem is very serious as it is impossible for the creatures to find stable ground that would allow them to resolve it."

A confession of perplexity, indeed, expressed in the 1st century, and which Rabbi Moses Isserles interprets in the 16th century as follows;

The three hypotheses considered by Rabbi Shiméon Bar Yohai pertain to the three major astronomical systems that have just been presented. "Free flight in the air" is the system of Al-Bitrogi. "The friction against the vault," is the system of the Sages of Israel. "The movement according to natural laws" is the system of Ptolemy. And it is regarding these three systems that Rabbi Shiméon Bar Yohai declares that each of them can serve as a key to build a complete astronomy, the question of which of the three systems is correct arises in all its breadth. When it comes to truth itself, in its real essence, it is impossible to rely on anything to know it. Three paths are therefore available to David Gans: that of submission to the authority of the Gentiles and to the Ptolemaic system; its most undisputed Jewish representative is the great Moses Maimonides. That of the Maharal, also acknowledging the scientific supremacy of the astronomy of the Gentiles, but placing above it a purely Jewish astronomy, which, however, is not scientific and holds, alone, the absolute truth. Finally, that of the Rema which ultimately leads, within the very vague and general framework of the simultaneous respect for Jewish tradition and the Ptolemaic system, to a painful perplexity. Three paths, which David Gans honestly presents in the epilogue of his book, as if to better excuse the undeniable fact that...At first glance, his treatise on astronomy is structured around the only common proposition of these three divergent methods, namely that scientific astronomical truth, in the scholastic and sometimes academic sense of the term, is on the side of Ptolemy.

But three paths that David Gans also surpasses in a movement that one feels vibrating throughout his book, with an moving constancy, and from which one perceives that it is provoked by the unexpected encounter with a man who was a disciple of the Rema, who nourishes him with perplexities, placed on his path by Providence: Tycho Brahe, the current master of astronomical science.

Or, as much and even more than the Rema, Tycho Brahe is filled with perplexity. Perplexity? How could men positioned around 1570, at the crucial turning point of the adventure, have avoided it? Copernicus's hypotheses were beginning to be seriously discussed in universities. Tycho Brahe, in 1572, discovered the new star, a discovery that made him aware of the breach opened in the Ptolemaic system. The Rema published (4 Prague) in 1570 one of his fundamental works, the Torat Haola, which he wrote in Krakow, where he taught rabbinical sciences and where, not long ago, Copernicus began his studies.

The two men, the Danish astronomer and the Polish rabbi, are searching for a way, an escape, a solution. The two believe they have found them, but actually end up with an unstable and shaky compromise. Tycho Brahe, as we have said, builds a system that simultaneously draws from both Ptolemy and Copernicus. But the difficulties remain so grave, the obscure points so numerous, the connections so loose, that in fact Tycho is still waiting for the Tychonid who will resolve the difficulties, who will bring forth light everywhere, who will transform the dull discord into sublime harmony. Sunk in the unsolvable, burdened as much as helped by the complexity and variety of his instruments, mired in the mass of his calculations and observations, he risked sinking into the obsession of perplexity, if, through a rigorous correction, shaped by courage and nobility, even if they were quixotic, he had not swept away this psychosis with a gesture of a great lord, laughing at life and its problems, prophetically trusting in the accuracy of his vision, if not for today, then for tomorrow. In the gallery of giants of astronomy, he had placed his own statue. If he had been preceded by geniuses, he would undoubtedly be followed by others. At least, he could invoke God as a witness to the stone he had brought to the edifice of eternity.

But if a Kepler were indeed able to confirm Tycho's system by surpassing it, not without struggles or temporary defeats, but ultimately with victory, driven by the irreversible impulse of his genius, how would Tycho's humble assistants, his technical aides, full of good will but with timid or weak wings, react? How would David Gans react, whose character did not deny the slow and skittish nature of the bird he was named after? Wouldn't a goose spreading its wings for an eagle's flight run the risk of ridicule?

Or, under the influence of Tycho Brahe, the wings of David Gans will indeed spread like those of an eagle in flight, and as a Master, he too will enter the arena. He will never, of course, reach the genius of Kepler. But, alone among the Jewish astronomers of the late 16th century, he will be able to measure himself against the new knowledge and the new problems at their highest level. Only he will be able to assign Jewish astronomy a place, its place, within the universal astronomical revolution, and this at the very heart of the strongest and most intoxicating whirlwind of that revolution.

3. THE SHOCK: DAVID GANS MEETS TYCHO AND KEPLER.

In every spiritual experience, there is a shock moment from which everything is set in motion, a sudden illumination that makes Archimedes jump out of his bath and run through the streets shouting Eureka. The Eureka moment of David Gans is not difficult to pinpoint in his book: he recorded it in chapter 25 of the first part of his Treatise. It is in this brief chapter that he recounts a key conversation he had with Tycho Brahe: its importance would overshadow everything that David Gans had already learned and all that he would still learn, everything he had taught and all that he would still teach. The title of the chapter: On the problem of whether Vastre is fixed [and the sphere is rotating] or, conversely, whether it is the sphere that is fixed and the star that is rotating. We see it, it's the famous astronomical debate opposing Alexandria to Jerusalem, a debate in which, according to the Talmud, Tractate Pesahim 4b, Jerusalem acknowledged its defeat and bowed before Alexandria. Statement of deficiency that allowed medieval Jewish astronomy to identify itself with that of Ptolemy[13].

Right from the start, David Gans, in a few lines, comments on the astronomical theme and recalls the strange submission of the Sages of Israel to the Wisdom of the Gentiles. If the manuscript of the Nehmnad Venaim had suffered the same misfortune as other manuscripts by David Gans, such as the Prozdor, which the author notes as lost, it would have been enough for this small chapter to remain for us to uncover, in all its nuances, the author, his thoughts, his method, and his doctrine. This chapter is the hub of David Gans' astronomical system: it also serves as a turning point in the history of astronomy within Jewish thought.[14]

TYCHO BRAHE SAID TO GANS: THE TRUTH IS ON THE SIDE OF THE JEWS.

In the central position of this hub, here is first the shocking experience: two contemporary non-Jewish astronomers enter the fray; they take a stand in the debate that once pitted Alexandria against Jerusalem, and they tip the scales, they, the non-Jews, in favor of Jerusalem, reproaching the Sages of Israel for having laid down their arms before the non-Jewish sages of antiquity.

Thus, the little word revealed at the beginning of the chapter is not just a stylistic formula. "Most ancient and modern scholars... including the Sages of Israel, according to the testimony of the Talmud... affirm and repeat that the stars are immobile and that only the spheres carry them in

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[13] I. This is the wording of the chapter title in the manuscripts and in the Table of Contents of the printed book. The words in brackets mark the beginning of the chapter in the book.

[14] 2. Salomon Munk (The Guide for the Lost, I, 8, p. 78-79) insightfully notes that the observation of the deficiency of the Sages of Israel (Treatise Pesahim 94b) applies in our editions of the Talmud to another astronomical theme than that of the movement of the stars and of spheres that are the subject of the discussion between Tycho Brahe and David Gans (specifically regarding the nocturnal trajectory of the solar orbit). Either Maimonides was working on a variant of the Talmudic text, or his extremist thesis (see above, p. 295) led him to apply the observation of deficiency and the entire set of problems mentioned on the page of Pesahim. Be that as it may, we believe, along with Munk, that at the time of David Gans it was not the Talmud that was cited but rather the commentary that Maimonides had provided, in a classical form, in his Guide. It is true that Maharal correctly applies the observation of the shortcomings of the Sages of Israel to the theme specified by the Talmud and not to the one mentioned by Tycho and Gans. (BH 107a, 109).

their movement..." Most... There is no consensus. There is a debate. One day and somewhere lived scholars who claimed the opposite, just as the Jewish scholars did before their surrender. These scholars of antiquity, David Gans will soon name them. But before recalling this historical fact, important certainly, but in the past, there is this much more decisive fact, brimming with current relevance, drawn from the lived history today by David Gans, namely that in Prague, in the year 1600, two non-Jewish scholars burst the apparent unanimity of the learned and take a stand in favor of the thesis once asserted by other non-Jewish scholars and, before them, by the Jews.

And these two non-Jewish scholars are not modest and unknown holders of chairs at some small contemporary university. One is the Master, the Unique, the *Coryphaeus* of the scientific assembly gathered by Emperor Rudolf in Prague, Tycho Brahe; the other is his immediate disciple, his collaborator, whose reputation is already reaching that of the Master, Johannes Kepler. Master and Disciple agree to take a stance against the theses professed by Alexandria, and, in a shocking detail, David Gans, the Jew, finds himself addressed by the non-Jewish Master Tycho Brahe, who says to him: "Your Sages did not act wisely by bowing before non-Jewish scholars." "[They became accomplices of a lie, for the truth was on the side of the Jewish Sages.]"

These are not words retransmitted by a third party or copied by him from a written document. He gathered them from the very mouth of Tycho Brahe, who, probably, had pointed out the passage from the Talmud, and he also collects the similar position of Kepler from the very mouth of the one who was, at that time, his colleague at the Benatek[15] observatory. These are not just empty words, spoken off the cuff. David Gans takes care to note that Tycho Brahe and Johannes Kepler's opinion is based on two criteria, to which the former had already dedicated a presentation in one of his books. The first criterion is classic: it is that of mathematical and logical proofs, of reflection, of the "philosophy" of astronomy. The second is entirely new: it is that of observation, of surveying the sky using remarkable instruments whose precision could not deceive. Thus pure reason was no longer the only factor at play. Empirical observation was thrown into the debate. It was taking a new turn, reflecting the truth of the Jewish tradition, due to a new orientation in astronomical thought.

A pivotal chapter, we were saying just now. He is, as we can see, two-dimensional. The truth returns to the Jewish fold, but it makes this turn by virtue of the movement that, since Tycho Brahe, has transformed the astronomer from a calculator into an observer. In this chapter, David Gans appears as one of those men of the 16th century who, instead of keeping his eyes fixed on the worktable, on the tables filled with numbers, on the books, the figures, and the equations, suddenly lifts his gaze to the sky, embracing and drinking it in through the instruments of a new optics. And this turning movement from the bottom to the top, from the earth to the sky, allows him to recover in the stars the Jewish truth that Ptolemy's *Almagest* had suffocated under the weight of its heavy pages.

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[15] The theme of Tycho Brahe is already introduced by David Gans in chapter 16, but in a more impersonal manner. It is, one might say, according to David Gans, the "first law" of Tycho Brahe's system, presented in the "conclusion of conclusions" of the *Nehmad Venaim*. (infra, p. 349). But in chapter 25, this law is communicated by Tycho Brahe to David Gans during a personal conversation.

AGAINST THE CURRENT OF JEWISH TRADITION.

Let's open an important parenthesis here. Observation complements logic, experience corrects mathematics; this approach, so crucial for the entirety of the astronomical revolution and through which David Gans now recovers Jewish truth, all this operates once again against the current of the choice made by Jewish science since the Middle Ages, and against the current of a principle that Maimonides had established as law in the 12th century and that the Rema had taken care to adopt in the last third of the 16th century.

Indeed, in the third chapter of the 10th part of the book Torat-Haola by his Master, the Rema, David Gans could read these few lines, supported by the authority of Maimonides (*Guide for the Perplexed*, 2nd chapter of the second part): "Everyone knows that this is the method of astronomers." "They place complete trust in the hypotheses inspired solely by reason, building upon these hypotheses the system of celestial motion, even though it is possible that in reality things occur in the heavens in a completely different manner." Thus, reason and reality were fractured in "classical" Jewish astronomy, just as they were in general astronomy, until the emergence of Tycho Brahe, whose remarkable instruments of observation would allow for the alignment of calculations with experience, reason with reality, and principles with truth.

Thus, reason and reality were fractured in "classical" Jewish astronomy, just as they were in general astronomy, until the emergence of Tycho Brahe, whose remarkable instruments of observation would allow for the alignment of calculations with experience, reason with reality, and principles with truth. And one of the shocking results of these engagements (which the invention of the telescope by Galileo would soon transform into weddings) was to do justice to the Sages of Israel, to those Sages who renounced their own truth by virtue of the ancient divorce. Among these sages, David Gans found himself compelled to count, with astonishment, I would even say with a touch of veiled shame, his revered master, Rabbi Moses Isserles!

Astonishment and embarrassment, yes, these are the feelings revealed in the continuation of the key chapter of David Gans' book. Certainly, there must have been, in Gans' psychological reaction, an inner jubilation, the feeling of revenge against the too numerous medieval controversies between Jews and Gentiles, where the latter always emerged victorious, if not through spiritual argumentation, at least through force. Like a magnificent fireworks display, concluding the reverse movement of the Renaissance, during which so many scholars among the Gentiles had lent a keen ear to the Rabbis, here were two non-Jewish geniuses casting into the flames of the pyre not the Jewish truth, but their own doctrine, defeated by that of the Jews.

But stronger than this triumphant sensation must have been the lingering anguish in David Gans's soul of having to pay the price for his trust in his Jewish masters. How much he must have suffered at the thought that a non-Jewish scholar had saved the honor of Jewish science. In his soul, the respect for his Jewish Masters was anchored too deeply for Azarya dei Rossi to have reacted otherwise. If he had found himself in the same circumstances, he would have disdainfully dismissed those among the Jewish Masters who had hurried to follow in the footsteps of the "Sages of Israel" of old and yielded ground to the "Sages among the Nations."

SAVING THE HONOR OF JEWISH TRADITION: TURNING TO ABRAVANEL.

It is from within the Jewish tradition that David Gans will strive to save the honor of Jewish science. The endorsement given by Tycho Brahe and Johannes Kepler is, indeed, of undeniable weight, but it is not enough for the disciple of the Rema, whose perplexities are now swept away, except for leaving the student troubled by the very fact that the Master could have been perplexed.

David Gans goes in search of a Jewish guarantor of Jewish truth. I find it in Don Isaac Abravanel, but in a way that deserves to be analyzed closely.

Indeed, the excerpt from Abravanel's commentary on Genesis I, 17 ("God placed the luminaries in the vault of heaven to illuminate the earth") that Gans cites in the second part of the chapter, along with the support for the assertions of Brahe and Kepler, is hardly conclusive. It concludes with the Midrash itself (Beréshit Rabba VI, 13), which forms the foundational theme of perplexity (Rabbi Shiméon Bar Yohai declares: We do not know whether... or whether... or whether... and the truth is inaccessible), on which the Rema also concluded his astronomical reflections. And Gans omits, in his quotation from Abravanel, a small phrase, which he will also make his own motto. "But for me, to escape doubts, I will continue to follow Aristotle."

However, Abravanel previously cites two witnesses, who were also non-Jews, who, since Antiquity, had taken the opposite stance to Aristotle and Ptolemy and, in the debate about the movement of the spheres and the stars, had affirmed, like the Sages of Israel, that the spheres were immobile and the stars were animated by free movement.

These two witnesses are Pliny and Plotinus. Each of these testimonies deserves to be subjected to an examination that will allow us to delve deeper into the critical moment that David Gans is experiencing. Regarding Pliny, Gans reproduces from Abravanel's commentary only these few lines: "Ancient philosophers such as Pliny and his school wrote in their book titled The Nature, a book highly valued by Non-Jewish Sages, that the seven planets move in the midst of celestial space." "Affirmation that he repeats three times in his book." In reality, the mention of Pliny made by Abravanel is much longer, as the assertion of the free movement of the seven planets is complemented by the following phrase: "The Sun, as for it, is in the middle of the planets; it is like the soul of the world, which it governs like a divinity." It is, as we can see, the literal citation of the famous phrase that allows historians of astronomy to see in Pliny one of the precursors of Copernicus among the Ancients. Next to Aristarchus or Plutarch: "The Sun revolves among the planets, governing not only the calendar and the Earth but also the sky and the stars themselves."

Regarding Plotinus, Abravanel says no more than what David Gans cites: "One of Aristotle's disciples, the greatest among them, Plotinus, who wrote books covering all areas of philosophy, also states, in full agreement [with Pliny], that the luminaries are not fragments of spheres, nor are they fixed upon them, but that the planets move in the air, between heaven and earth, while

the spheres are fixed and immobile."[16] A citation that one would vainly search for in Plotinus, but which can be found, in various forms, scattered in abundance without any attempt to unify them into a system, in the great Neoplatonic and Neoplatonist movement, which has been operating underground since the 14th century and which, towards the end of the 15th century, especially in Italy, breaks through to the surface and leaves no enthusiast among the vanguard and already the first generation of the Renaissance untouched. Isaac Abravanel belongs to that generation of Leonardo da Vinci, with whom he shares a mobility of spirit, an openness to new ideas, and an interest in all the fields that the Renaissance would unveil to the curiosity and admiration of the 16th-century man. The "critique of texts" has not yet been invented, and people continue to attribute to Aristotle, Plato, and Plotinus ideas that others advocated in antiquity, but which, in reality, the minds of the 14th and 15th centuries had reinvented after an eclipse of more than a millennium.

With Pliny, it is Aristarchus who is resurrected under the pen of Abravanel. With Plotinus, it is the Pythagoreans.

For David Gans, Pythagoras is the true ancestor of Copernicus.[17] He states it explicitly in the epilogue of *Nehmad Venaim* in the magnificent paragraph he dedicates to this "unique genius of his time, this new Ptolemy," and, sheltering behind the Jewish authority of Isaac Abravanel, which is itself supported by Pliny and Plotinus. David Gans, as we can see, is playing with fire: his key chapter, if it had been inspired by the logic we have followed so far, could have culminated in the following revolutionary assertion: indeed, the Sages of Israel were willing, for reasons known only to them and which they did not wish to reveal, to adopt, provisionally and as a mere working hypothesis, the non-Jewish astronomical system of Ptolemy. But, in reality, they were the holders of the contrary astronomical truth, which many non-Jewish scholars had also adhered to in antiquity, but which, just recently, Nicolaus Copernicus has restored to its brilliant prestige. To Ptolemy's erroneous geocentric conception, Judaism opposes the heliocentric truth of Copernicus. Here is the confidence that Tycho Brahe and Johannes Kepler shared with me, could have, would have, concluded David Gans this 25th chapter of his first part... but then the eleven other parts of the *Nehmad Venaim* with their 280 other chapters would have taken a completely different turn.

In this hub, once again, something is moving. But this time, it seems, in the background regarding David Gans' adherence to new truths, of which he now knows they are identical to the Jewish truth. By not stating it explicitly, David Gans will conclude like his witness, Isaac Abravanel. He will also build his book, just like Abravanel did for his commentary on the Ptolemaic system. From the very first chapter, while he dedicates such a magnificent praise to the Copernican system in the epilogue, he rejects it and relies on... 4 Ptolemy, for the reason that most scholars, and particularly the most recent ones, refuse to accept the Copernican thesis.

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[16] 1. The copyists and the printer of *Nehmad Venaim* repeat the name of Plotinus twice, while the context clearly establishes that these are two different ancient authors from one another. As a bonus, this is a quote from Abravanel, there is no doubt: in Abravanel's text, the first author mentioned is Pliny and the second is Plotinus.

[17] 1. Above, p. 283, note 1.

David Gans is thus returning to the fold, after having given the impression of being at the forefront.

THE SITZ-IN-LEBEN OF THE CONFIDENCES OF TYCHO AND KEPLER IN GANS.

Paradox? Contradiction? Confusion? Certainly, all these terms apply to David Gans's position, but they are not derogatory at all. How simple and almost necessary their appearance is, indeed. This illogism is in the very logic of the *Sitz im Leben* ("Setting in Life") of this key chapter, written during the few months of 1599-1600. David Gans is in contact with Tycho Brahe, who is still alive ("Tycho Brahe told me..."), and with a Kepler assisting the Master in his research. Where were Tycho Brahe and Johannes Kepler in their scientific journey at that moment? Very precisely at a point that the first will never surpass, and the second only much later, a point involving the paradox, contradiction, and confusion that we observe in their modest but attentive collaborator David Gans.

He notes that the confidence placed in him by Tycho Brahe is based on the dual arguments of his written work and the observations made thanks to the marvelous instruments that no one had before him. The conclusion to which these meticulous and multiple observations led Tycho Brahe is that the movement of the planets involves whims that make them appear sometimes within the solar orbit, sometimes outside of it. The planets therefore possess an intrinsic mobility; they are not chained to the spheres, nor are they fixed to them like nails; they are autonomous.

But nothing in the work of Tycho Brahe, nothing in his empirical explorations, nothing in the rare fragments of confidences he sometimes shares, and his assistants (and we have an example of this in Gans's chapter), nothing explains this mobility, no law establishes or defines it. It is an observation, bewildering for those who believe in Ptolemy, enlightening for those who wish to follow Copernicus, but a raw observation that lacks the support of a theory. It leaves the viewer perplexed.

The same remark for Kepler. He confirms to David Gans that the observation of the planets shows that their orbit is not regular, and that it sometimes stretches to take the shape of the Hebrew letter *Kaf*.[18] If the indication had been given a few years later, it would probably have been stated as follows: planetary orbits are not circular as taught by Ptolemy and also Copernicus. They are oval (elliptical, we would say today, but Kepler himself constantly circled around the term ellipse, without ever using it!). But we are still far from the *Astronomia Nova,* which will only appear in 1609, and the joy of the ellipse, the famous first law of Kepler, is moreover buried in an impenetrable set, and someone other than the author himself will clarify things later, long after the death of David Gans in 1613. Around 1600, Kepler is still immersed in the atmosphere of the *Mysterium Cosmographicum*, published in 1596, where theology occupies

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[18] Kepler knew Hebrew, which he had learned in Tübingen from Georg Weigenmaier. It is known that in his latest work, the *Somnium* (the dream of a journey to the moon), he gives the moon its Hebrew name of Lebana or Levana, explaining that he preferred this term to the Greek name "Selenitis" because Hebrew words, being less familiar to our ears, inspire a greater sense of fear and are recommended in the occult arts. See Kepler's *Somnium*, translated with a commentary by Edward Rosen, London, 1967, 53.

as much, if not more, space than astronomy. But this one, at least, has already led Kepler to the groundbreaking realization that the circle is not the perfect cosmic shape, that the cosmic mystery lies elsewhere, in a collection of figures, all of which could serve as the geometric foundation for planetary orbits. The magic of the circle is broken, but we do not yet know what other magic we are heading towards. And it is precisely this confirmation that Kepler provides for Gans: it is disconcerting because it is not stated in the form of a law replacing those of Ptolemy, while simultaneously undermining the Ptolemaic system at one of the most vulnerable points of its armor.

It is on Ptolemy that we must still and always rely. Kepler I will explicitly tell David Gans a little later, and Gans carefully notes the remark in chapter 218 of his book. This concerns the reminder of the revolutionary theories of Al-Bitrogi, which were extensively discussed by Gersonides and, more recently, by the Rema, who introduced them into his eclectic overview of current astronomical theories in 1570. No eccentricities, no epicycles, had declared Al-Bitrogi. Enough of Ptolemy, Hipparchus, and Al-Bitani! Absolute freedom of the cosmos where the planets complete their courses like horses in the racetrack! Stupid theories, replied Kepler. Gross mistakes, worthy of clods who stupidly gaze at the sky without guessing that it conceals laws. In reality, says Kepler & David Gans, all these opponents of Ptolemy are followers of ancient astronomers who each built abstruse theories similar to that of Al-Bitrogi. But these "revolutionaries" ignore that in the *Almagest*, Ptolemy has long since victoriously refuted the Ancients, simultaneously sweeping away the fantasies of the "moderns." Copernicus based all his calculations and the foundation of his theory on the Ptolemaic system.

Thus, the *Almagest* remains the Bible of Tycho Brahe and Kepler, just as it will remain that of Galileo, and yet...

PTOLEMY IS RIGHT... AND YET...

And yet something has begun to move. Galileo will know it for the earth and will challenge his conviction right in front of the Inquisitors, his judges, at the very moment of his solemn retraction.[19]

David Gans, within the modest limits of his research, also knows that something has been set in motion. In the key chapter 25 of his book, a chapter in which he recounts how he received from the mouth of Tycho Brahe and Kepler the revelation of what was "moving" in the Ptolemaic system, simultaneously discovering that the secret of this deviation was possessed by the Sages of Israel all along, he will ingeniously resort to a stylistic device to give an expressive echo to his

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[19] 1. It seems very interesting to us that around 1600, at the very moment when David Gans is gathering the confidences of Tycho and Kepler, Galileo is writing in Padua (but without publishing it yet!) his System of the World. He discusses very precisely, based on Aristotle (supra, p. 283, note 1), the problem of the movement of the stars, which is the subject of chapter 25 of Gans' Nehmad-Venaim, and he also opts, after discussing the issue, for the Ptolemaic thesis of the fixity of the stars and the movement of the spheres! E. Wohlwill (op. cit., p. 209) invites us to sense the underlying irony in these lines written by a Galileo who had long taken sides with Copernicus. I don't think it's a matter of irony, but rather this symptom of indecision, perplexity, and helplessness in breaking away from the Old System, which we find simultaneously, around 1600, in Tycho Brahe, Kepler, and Galileo. How could it have been otherwise for the humble David Gans?

discovery.

Indeed, the Talmudic theme of "the bird flying in the air" had been applied, as we recall, by the Rema to Al-Bitrogi's system. David Gans now applies it to this set of orbital eccentricities that were pointed out to him by Tycho and Kepler. But he plays like this, and we think that the wordplay is deliberate, on the ambiguity of the metaphor. For in the Talmud and rabbinic texts, "the bird flying in the air" refers to unsupported assertions, theories without proof, and, more specifically, the doctrine of the Rabbis when it cannot be confirmed by the biblical text from which it claims to derive.

Thus, through the choice of this metaphor of flying wings, David Gans manages to position the astronomy of the Sages of Israel at the precise point where general astronomy reaches the peak of imprecision. This one is now, along with Tycho Brahe and Kepler, an unsupported assertion, a theory without proof, a doctrine supposedly rooted in the Bible of the *Almagest*, yet it cannot be reconciled with that Bible. The astronomical truth is Jewish; it has revealed itself today to non-Jewish geniuses, but a veil still covers it: that of paradox and contradiction. You think you have it in your hands: here it flies away like a bird, swirling in every direction, including the nonsensical ones, resembling the absurd trajectories of planets that continue to guard their secrets jealously. It is therefore on Ptolemy's *Almagest* that David Gans built his book.

He warns us about it, as we just mentioned, right from the first chapter.

It is also on empiricism that he builds it, a solemn warning given by the author as early as the third chapter, whose title is evocative of the spiritual atmosphere we have just mentioned: "On the futility of seeking a cause or a factor that could explain why the Earth is suspended in the midst of the cosmos in the void." Yes, the why, the cause, the explanation— in short, the laws, and among them the supreme law (the law of gravitation that Newton will only discover 150 years later) we do not yet possess. We know that the Earth is round, that it rests in the middle of the planetary system, and that this implies a host of problems, particularly the issue of the stability of this sphere thrown into the void, as well as the existence of human beings who, on the opposite side of Europe, walk with their heads down. But wanting, with Aristotle, to explain the stability of the Earth by the influence of invisible celestial forces is as futile and foolish as refusing to acknowledge the existence of people in the antipodes on the grounds that they would be doomed to fall into the void. "We have reached a point," said David Gans, "where it must be understood that the mission of astronomy is to observe, but not to explain; to note the facts, but not to seek their causes." Already, Isaac Israeli in the Middle Ages warned the astronomer against the temptation of seeking the "why?"[20] Does the most ingenious goldsmith boast of knowing the origin, nature, and composition of the precious metals he works with? Thus the astronomer "Would it be foolish to search for the causes and waste one's time? Celestial laws certainly exist, but they are the secret of God, who has not revealed the key to the human creature." This one can observe even in its most minute—and most wonderful—details the cosmic edifice, but it does not have the power to uncover or understand its bones.

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[20] Yesod, Olam, ITI, 1,

It is in the realm of the miraculous that we must address the problem of explanation. The waters of the Red Sea part, those of the Jordan as well, and the sun "is silent" at Gibeon during the time of Joshua. Who would doubt it? But who would be crazy enough to imagine nature and the work within these phenomena? Like these "miracles," the laws of the cosmos transcend nature and surpass reason. Let it be enough for the reason to explore, to know, and to admire the existence of the cosmos, its reality, that the advances of scientific observation, the ever-increasing perfection of instruments like those invented by the genius of Tycho Brahe, make it accessible today as it has never been before.

Such is the methodological position of David Gans. She is no different from that of Tycho Brahe, from that of Kepler — whose laws are, in the eyes of the one who discovered them, merely observations and descriptions — from that of Galileo — whose telescope only serves to broaden the field of observation. For all these contemporary astronomers and masters of David Gans, the explanatory keys are still firmly held in the hands of God[21], and the human creature does not feel frustrated for only possessing the power to increasingly discover the Divine work, without ever managing to explain it. No Promethean spirit among these giants who feel strong in the face of God for the sole but so fulfilling reason that the creator allows them to embrace the cosmos with a single glance at its Divine dimensions. It will take Isaac Newton to encapsulate, in the narrow rational capsule of a mathematical formula, the explanation of this gigantic panorama, still resonating with musical harmonies in Kepler's work. Only then do the observations of Galileo and Kepler also become explanations, laws. But in 1600, Kepler and Galileo would have, like Tycho Brahe, co-signed the statement of faith submitted by David Gans, as a warning, in the very first chapters of his book.

But if the astronomical edifice of David Gans is built on this preliminary warning, David Gans also knows, with an equally full awareness, that the balance of the structure is unstable, and he does not hesitate to point out the instabilities, the difficulties, the inconsistencies. He raises the issues, asks the questions, and accepts in advance the risk of answers contradicting the *Almagest* or, more often, the risk of a dead end: your question is valid, but for now, it has no answer.

The entirety of this valiantly fought battle in the field constitutes the living and original part of David Gans' book: it draws into the struggle the team of astronomers of which he is a part at the castle of Benatek and places them at the foot of the wall. Tycho Brahe, Johannes Kepler, Johann Müller, and all the other eminent scholars in the service of Emperor Rudolf are consulted by David Gans, who carefully notes their responses. In the dryness of the purely theoretical presentation, elements of an uninterrupted dialogue thus burst forth, and we will follow its interesting development.

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[21] 1. Cf. Scholder, op. cit., 62. — This is Osiander's thesis in his Preface to Copernicus's book!

4. THE DIALOGUES AND THE PRAGUE CONFERENCE: DAVID GANS AT THE HEART OF THE REVOLUTION.

Let us first note the sense of satisfaction with which David Gans records the successive agreements given by his non-Jewish Masters to Jewish astronomy. After the overall confirmation recorded in chapter 25, there is the sudden acknowledgement of the mathematical erudition of the Rabbis of the Talmud concerning the duration of the solar year (chapter 164), then the lunar year (chapter 203). The importance of these two data in the establishment of the Jewish calendar is clear: unlike the Christian calendar, based exclusively on the solar year, and the Muslim calendar, based exclusively on the lunar year, the Jewish calendar is the only one, among the calendars of the three biblical religions, to combine the two durations in a synthesis, formerly empirical, but which in the 1st century AD, the Patriarch Hillel II established, definitively, on a mathematical basis. The mathematician Rabbi whose calculations and tables Hillel II used was called Adda bar Ahava, and had lived a century before him, at the time when Ptolemy had just published his own calculations in the *Almagest*.

This is an opportunity for David Gans to summarize the universal history of astronomy, which he explains in detail in the epilogue to his book. But he insists on the difficulties of the mathematical problems raised by the precise delimitation of these indispensable data 4 the astronomer and on the fact that none of the Ancients had arrived at conclusions as precise and acceptable as Ptolemy's. Rabbi Adda, in proceeding with his own calculations, is very close to Ptolemy's but nevertheless quite far from it. However, both Tycho Brahe and Kepler, consulted on this subject by David Gans, propose their own formulas, and it turns out that for both the solar and lunar years, they are closer to those of Rabbi Adda (only six minutes difference!) than to those of Ptolemy.

For the lunar year, this precision is all the more important as it implies Rabbi Adda's knowledge of the need to admit epicyclic movements for the lunar revolution, a hypothesis dismissed in Ptolemy's time, but vigorously confirmed by Kepler in Gans (chapter 200). Thus, there can be no doubt about the evidence already gathered in the key chapter: traditional Jewish astronomy - its “secret”, to use Talmudic terminology - is based on data that the new astronomy of the twentieth century has finally brought to light, after the long eclipse of the Middle Ages.

And Gans can now take the liberty (he makes no apology for this in chapter 213) of discussing on an equal footing with the medieval giants of Jewish astronomy, such as Maimonides and Isaac Israeli. If the latter, obsessed by Ptolemy's system, are sometimes unable to find their way in thealmudic data that contradicts Ptolemy's, it's because they recognize the great truth that David Gans is the first Jew 4 to hear from the very mouths of today's giants of universal astronomy:

Ptolemy is wrong on many points, and it is in the Talmud, in some of its apparently aberrant assertions, but also in some of its deliberate silences, that we find the "secret" of the astronomical truth, rediscovered today by Copernicus, Tycho Brahe and Kepler.

But apart from any apology, there are, in the *Nehmad Venaim*, those disinterested questions asked by his Masters and & collaborators, out of simple curiosity, because he wishes to acquire exact knowledge on specific points. If books such as the *Almagest* or the Jewish treatises on astronomy leave him thirsty, why not take advantage of the books already published or being written by the men he so often meets at Benatek Castle or in Prague itself, why not take the opportunity of a personal consultation, an interview with Tycho Brahe, Kepler or Muller, to try to solve a problem or, at the very least, to pose it correctly? The importance of consultations varies according to their purpose: some are merely episodic. Others could have implications for the general history of astronomy, and make us all the more sorry that David Gans's *Nehmad Venaim* has been so totally neglected by historians of the astronomical revolution in the 16th century. We give them here in the order in which they appear in Gans's book, leaving it to specialists to one day make the scientific assessment.

From the very first chapters (12-20) of the first part of his book, David Gans comes up against the general description of sphere motion in the Ptolemaic system: the eight spheres carrying the seven planets and fixed stars are packed tightly together, like onion skins, and perform a regular motion (complicated by epicycles) from West to East. Surrounding them all, here's the ninth sphere, which, without any epicycles, performs a regular circular motion in the opposite direction to the other eight spheres: The sphere moves from East to West, dragging the entire celestial system into a rotation which, in itself, explains the existence of the 24-hour day, the *dies naturalis*, according to the Latin expression introduced by David Gans in his presentation in Hebrew (chapter 17). Without the hypothesis of this diurnal sphere, everything would happen on the whole earth as it happens in the heavens (as David Gans explains in the very modern cosmographic sections of his book): day and night would each have a duration of six months.

But neither Ptolemy nor any of his successors gave a satisfactory explanation of this double movement. Theologically inclined authors (among the Jews, Gans cites Joseph Albo in his *Sefer Ikkarim IV*, 3) like to distinguish between the physically determined movement of the eight spheres and the free movement of the ninth, which depends solely on the unfathomable will of the Creator.

As a rationalist, David Gans asks how it is physically possible for a single sphere to drive the whole cosmic system in the opposite direction, and how, more generally, two opposing movements can coexist in the same system.

Kepler's answer to the first question (Chapter 14) is: "We must extend the problem," explains Kepler, "to all the spheres. It is not only the ninth sphere that moves all the others, but each sphere moves simultaneously under its own force and under that of its neighbors. An amusing parable illustrates the point: imagine a ship moving from West to East, and on that ship, a man also moving from West to East, and in that man's hair, a fly, also moving happily from West to East. All three will eventually cross the distance from the Western starting point to the Eastern finishing point, thanks to the combined effect of their three movements.

Kepler is known for his jokes: flies and fleas play an important role in the examples he uses to illustrate his theories. David Gans must have had a less caustic temperament, for in Chapter 16, returning to Kepler's interpretation, he proposes a more serious example to illustrate it: that of a pregnant woman moving from East to West, and carrying the fetus in her womb in this direction, although at the same time the fetus may be moving in the opposite direction, from West to East, in her mother's womb, under its own power.

But it is from the mouth of Tycho Brahe that David Gans gathers the answer to the second question, which renders the first unnecessary, in chapter 16. Two opposing movements, one determined, the other free - did this seem impossible to you? Certainly, in the logic of Aristotle and Ptolemy. But we now know (this is the secret that Tycho Brahe will reveal to David Gans in the twenty-fifth chapter of his book, with which we began our presentation, and to which Gans refers here, in chapter 16), we now know that these contradictory movements exist not only in the opposition between the 9% sphere and the other eight, but that each sphere carries these contradictory movements within itself: The old Jewish truth, “the spheres are fixed, but the planets are mobile”, demands a fundamental overhaul of the Ptolemaic system and, as a first repercussion, renders the hypothesis of a ninth sphere entirely useless. Planetary orbits obey complex and contradictory forces, which suffice to explain the arbitrariness of a dual motion that ensures each planet its orbit and the earth its *dies naturalis*. If there is will and arbitrariness (whether of Divine inspiration or of purely natural origin), they apply to the whole system and, once again, render the hypothesis of the ninth sphere useless.

Let's repeat that it's up to specialists to appreciate these few pages from the *Nehmad Venaim*. But even to the uninitiated astronomer, their purely historical interest is obvious. Georg Alter has already pointed this out. First of all, we can see that Tycho Brahe and Kepler were still suckling at the bit, unaware of the laws of gravitation that Newton would only discover a century and a quarter later. But above all, we can see that at the time Gans submitted his question to them, Kepler's conceptions were still much more rigid and Ptolemaic than Tycho Brahe's already very flexible ones. While Tycho Brahe's premature death prevented him from advancing further into a meta-Ptolemaic universe, Kepler remained mired in Ptolemy's system for a long time to come, and was never able to find a scientifically correct way out.

While Tycho Brahe's respect for Ptolemy is undeniable, the Master was not afraid to correct and modify the astronomers' Bible on important points, whereas Kepler remained entirely faithful to the data of the *Almagest*. This is clear from other passages in Gans' book than those we have just presented.

THE PHENOMENA OF PRECESSION: JEAN MULLER'S THEORY.

In Chapter 130, for example, Gans adopts Tycho Brahe's new figures for the physical phenomenon of precession, which profoundly correct those of the *Almagest*. In chapter 219, the distance from the moon to the earth is called into question: David Gans describes Tycho Brahe correcting both Ptolemy's and Copernicus's figures simultaneously. Faced with these audacities, Gans' reaction is always the same. He turned to his colleagues, Tycho Brahe's collaborators, and in particular to Jean Muller, who confirmed the bold, new assertions. In the case of precession, in

particular, he brought into play a phenomenon that, as Gans writes, is referred to in Latin as *demotus trepitianus* and in German as *die zittrige Bewegung*. But what perspectives then opened up before Gans! The dizzying idea of a progressive and radical modification of the celestial sphere with all its bodies is set out in chapter 131, which follows on from chapter 130, where Jean Muller supports Tycho Brahe's theories. The conclusion of both chapters is the same, and shows David Gans's dismay: "As far as Jean Muller is concerned, I confess that I can't discuss his thesis, as I haven't yet come to a complete understanding of it. I still need to dig into it and examine it more carefully than I have so far. Let me conclude by saying that Jean Muller's thesis, with all its dizzying implications, escapes our understanding. We're still like a lost flock, searching in vain for intellectual security. I already expressed my opinion in chapter 25 (the key chapter): we're up against extremely serious problems here, and to solve them, we & our humble creatures, will probably have to wait many more years.'" [22]

Who, poor Gans! The long years that still separate you from Newton, but, alas, when he appears, you, long since, will no longer be of this world. David Gans feels safer with Kepler, that is, with the Kepler he knew between 1599 and 1613. Of course, Kepler also provided new figures (on the alignment of the planets with respect to the sun, chapter 108), new data (lunar epicycles, chapter 200), and a general system of planetary cycles that David Gans recapitulates by drawing on him (chapter 241), but, overall, there's nothing in him that's "revolutionary" in the sense of Tycho Brahe's or Jean Muller's confidences. On the contrary: when Gans refers in chapter 218 to certain astronomers who dared to challenge the system of spheres and epicycles of Hipparchus, Ptolemy and Albatani, he finds in Kepler, as we have said, an eloquent and brutal defender of these *coryphaeos* of Antiquity and the Middle Ages. Gans hears Kepler vituperating these "boors" who dare to speak out against Ptolemy and who are, in the end, nothing but miserable plagiarists of ancient Ptolemaic scholars whose theories and arguments were, precisely, unassailably refuted by Ptolemy. Let's stick with Ptolemy, and it's no doubt because this is the refrain that Gans constantly hears in Kepler's mouth that he begins by addressing a problem whose implications,

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[22] It should be pointed out that we must be careful not to confuse our John Muller (Johannes Muller), mathematician to Johann Georg, Elector of Brandenburg, with his namesake Johannes Muller, the illustrious Regiomontanus. The latter, who lived in the XV" century (born in Koenigsberg, 1436, died in Rome, 1476), could not have known either Brahe, Kepler or Gans! Nevertheless, Freedman (p. 24) identifies seven serious authors of the 11th century who make the confusion, I've spotted others among our contemporaries. The mathematician Jean Muller, quoted by David Gans, was already Tycho Brahe's assistant at the Island of Hven in 1598. He arrived in 4 Prague in March 1600, where Kepler had just preceded him in February. He is best known for the picturesque way in which Kepler's wife recounted his hasty departure from Prague in a letter to her husband (Kepler, Werke, 14, 169, letter 188 of May 31, 1601): "Der hanss Miller ist den 29 Mai mit seiner frau darvon und haim, der diho Prei hat im abgeförtigt und hat im goben was er im hat zugesagt, aber vom Khaiser ist im Khain, heler nit worten. .." (Hans Muller left on May 29 with his wife, his clique and his slaps. Tycho [Brahe] compensated him and gave him everything he'd promised, but he didn't get a penny from the Emperor). We know that Kepler himself died in Regensburg, on a bed.

Did this hasty departure put an end to Jean Muller's career? As Dreyer (Tycho Brahe, 289) seems to imply: "after which he disappears from the history of science altogether". Jean Muller seems to have resumed his duties with the Elector of Brandenburg. In any case, the formulas used by David Gans can be interpreted in the sense of an oral consultation of Muller by Gans in Prague, but also in that of a correspondence between Gans and Muller, after the latter had left Prague. See Freedman's discussion of the problem (p. 28-29). We propose to clarify this point in the critical edition of Nehmad Venairm. In any case, for the moment, let's remember that in David Gans we have a witness to the activity and thought of a fin de xvi siecle astronomer worthy of the attention of historians of science.

however, will be so important that David Gans will feel obliged to submit it, in the end, to the whole of Tycho Brahe's team, in the context of a veritable colloquium, of which David Gans writes the minutes in chapter 161 of his book.

THE PRAGUE CONFERENCE

“Despite my fervent desire to be brief and concise, I cannot help but elaborate here, given the importance of the issue, and while striving to remain true to my principle of conciseness, I find myself extending my discussion longer than usual on the subject at hand.” And it is seven columns that David Gans unfolds before his reader, but seven exploratory columns, along which the problem is presented in four parts, each adding an additional question mark to the previous one, without the author arriving at a solution. “Know this, dear reader,” David Gans will write in search of a conclusion that might offer his unsatisfied curiosity a meager consolation, “know that I have submitted this knot of problems and perplexities to the learned scholars endowed with genius who form the unparalleled college of astronomers in science and knowledge gathered by our Lord Emperor Rudolf, whose glory shines forth.” They spent several days pondering the problem, graciously engaged in a lengthy debate with me, and felt no shame in humbly admitting, in the end, that they have no correct or sufficient answer to this problem.

What a striking spectacle! A scientific conference gathers in Prague in the year 1600, Tycho Brahe, Johannes Kepler, Johann Müller, and other astronomers and mathematicians among the most famous of the time, to listen to a problem raised by the modest Jewish scholar David Gans. Perhaps the Emperor Rudolf himself is following the debates, behind the veil that preserves His Majesty! And the conference concludes with an admission of inadequacy. The problem posed by David Gans is one of those that even Brahe and Kepler could not find a solution to in the year 1600.

And for good reason! For it is nothing other than the impact on astronomy of maritime discoveries, now over a century old. Here, we are touching on one of the intersections of the discovery of the New World and the astronomical revolution. It is no longer Copernicus that is at stake, but Columbus, Vespucci, and Vasco da Gama who come into play. They have altered the shape of the Earth. At the same time, they changed that of Heaven. Even if Copernicus had not overthrown Ptolemy, the great navigators would have dethroned him themselves.

From the outset, the captivating interest of this chapter 161 of the *Nehmad Venaim* by David Gans. He gathers upon himself, in a central astronomical problem, the dust of issues raised by the cosmographic revolution. Here, the significant emphasis placed by David Gans in the third part of *Nehmad Venaim* on the "geographical revolution" finds its true explanation. It is not only out of curiosity that the expert of the Sky must be an expert of the Earth: the latter has undergone changes over the past century that necessarily reverberate in the Sky. If the breastplate of Ptolemy is struck on land, the mark of the wound is found in the sky.

THE PROBLEM OF THE PRIME MERIDIAN.

Certainly, the problem itself is not new. It is that of the prime meridian, or, to speak with David Gans, the problem of the point on Earth where each day of the week begins to be designated by its name. Antiquity and the Middle Ages were well aware that the problem is linked to the empirical data of geography. The more the inhabited world expands, the more the 180 degrees of the sun's daily revolution also extend, and the 12 hours of human daytime must conform to a law of extensibility, the reference points of which must be known from origin to conclusion if we want this day to be truly human, that is to say, valid for *all humanity*.

This is the problem that David Gans begins by presenting first to Kepler alone (chapter 99), and the response he receives is satisfactory but incomplete. It only concerns the weekdays taken for themselves. Or, David Gans, for specifically Jewish reasons that we will uncover shortly, needs a literally global explanation, a key! Allowing to embrace the entire globe in the movement, global as well, of the whole week. He is now submitting to his colleagues at Kepler, to the entire team at the Benatek castle, the problem in its universal form.

Since Ptolemy and until the 15th century, the prime meridian had shifted by several degrees. In proportion to the breakthroughs towards the West, into the Atlantic, or towards the East, all the way to China, We had arrived, however, and maintained the fiction of a sort of "universal day" as long as the gap, let's say from the Canaries to China, did not exceed 18 hours. Did the long summer days not reach that duration, common in this season to all of humanity? And through a fictitious mathematical transposition, could one not conclude to a day like this, albeit abstract, in winter?

But what upheaval in this framework since the discovery of the New World, provided that we take this discovery seriously and accept it in its exact data, as David Gans elaborately and masterfully presents in the third part of his book on astronomy!

THE FATAL ERROR.

"We have lived until now on a fatal mistake!" exclaims David Gans in Chapter 161 of his book. "We, the Jews, as much as the non-Jews!" Our entire system was built on the foolish hypothesis that the southern hemisphere of the globe was submerged in water. Well, in such a conception, 180 degrees were enough to define the human solar day. The nocturnal stroll of the sun, the 180 degrees it accomplished at night beneath the waters, could only interest the aquatic folk. Would humanity worry about how “fish counted their days?”

But today, now that we know, with absolute certainty, that at the antipodes of our three old continents there is an inhabited continent, that the earth does not plunge into the sea, and that while it is night between the Canaries and China, it is day in New Guinea—moreover, today, now that we know, with absolute certainty, that there are not three continents, but eight, and that on two of these eight, even if they are not yet inhabited at this moment, the day is not 24 hours long but six months! So today, who will tell us when this "day" will begin that would be the same for all of humanity?

LET'S LEAVE JULES VERNE

As if to spice up the question, David Gans recalls in chapter 162, which immediately follows that of the "Prague Conference," that we now know that "the circumnavigation will either gain or lose a day for its champion, depending on whether he undertakes it in the East-West direction or the opposite." Gans makes sure to specify that the duration of the "world tour" is of no importance. To specify that the duration of the "around the world" trip does not matter. Whether the journey around the world takes many years or just a few brief years, it does not change the outcome; it does not alter the astonishing hypothesis that follows, which is quite new: imagine Ruben, Simeon, and Levi gathered at a single point on the globe. Ruben is going to travel around the world heading West. Siméon is off to make his world tour heading East. Lévi, as for him, doesn't move. "When the three little men meet again, and Lévi will say: today is Tuesday, — Ruben will retort, — but no, it's Monday, and Siméon will reply, — but no; it's Wednesday, — and there will truly be a difference of two days between Ruben and Siméon."

One could not better anticipate the adventures of Phileas Fogg. One could not better pose the problem in its insurmountable scope. For, in the end, as Gans states explicitly in chapter 161, everything derives from an absolutely arbitrary choice, and it is all about the matter. (49c). The meridian origin does not exist in physical reality. It can only be defined by an arbitrary decision of men. The finding of inadequacy that concludes the Prague Conference constitutes the only rational conclusion of a debate whose characteristic is precisely that it cannot have a conclusion. But Brahe, Kepler, Muller, Gans, were not yet aware of this rationality of uncertainty. Simply, they had a vague feeling about it, wrapping this awareness in the humility of an admission of ignorance. Long after them, we will begin to understand that reason dictated settling into the arbitrary, and this was, for two centuries, the anarchy of the multiple original meridians, until in 1884, finally, an international convention arbitrarily established the meridian so passionately sought by David Gans at Greenwich.

THE JEWISH IMPORTANCE OF THE ISSUE: THE ABSOLUTE SHABBAT.

But why did David Gans put so much passion into this research? Having noticed the arbitrary element that encompassed his question, as we have just seen, why did he persist in wanting to find an answer that was, unlike the foundations of the question, not fictitious, but real; as real as the physical data of nature? For Tycho or Johannes, the question might indeed seem trivial. But not for David. For when he speaks, in his examples, of Levi, Reuben, and Simeon, these gentlemen are, like David Gans himself, Jews. Or, Jews can, like Christians, be perfectly indifferent to the fact that a given solar day is Tuesday for one, Monday for another, and Wednesday for the third. But the Jews cannot remain indifferent "to the scandal and the ridicule" (49d) that would arise from the fact that the 24 hours of Shabbat are not covered, for all Jews around the world, by a single and the same solar day.

For the Jewish calendar has a remarkable feature. In contrast, indeed, to the Christian calendar, heir to the Greco-Roman world, which has chosen the solar revolution as its basis, In contrast to the Muslim calendar, which originates from the Eastern environment and revolves around lunar cycles, Judaism establishes its calendar on a bold yet resilient bridge, unyielding in all circumstances, connecting the sun and the moon. However, in this balance holding the year and

the month in equilibrium, the Jews have placed a third element, that of the week, centered around the Sabbath.

“It is evening and it is morning” (Leviticus 23:32): from one evening to the next, this is how the Jewish day is counted, according to the very principle of creation that places evening before morning: “It was evening, and it was morning, one day” (Genesis 1:5). Six days pass in this way, in accordance with the account of Genesis, none of them bearing a name, for their characteristic is to lead to the *seventh day*, the seal and conclusion of the Divine Work. And on the *seventh day*, preceded by its entourage of six days, together with them, constitutes the *Jewish Week*.

Such is the beginning of the Jewish measurement of time. It's simple, in its division of the day and the week. It is unchangeable because it has its roots in the creation story. It is original in the importance given to the vigil, to the precedence of night over day. All Jewish holidays carry this mark of feverish preparations, during the day that precedes them, then, at sunset and with the appearance of the first stars, a sudden transfiguration occurs, a shift from activity to relaxation, from the mundane to the sacred. The entrance into the night is solemn, fervent, joyful. Human communion in the Synagogue first, then around the family table, removes from the night its terrifying atmosphere. The vigil becomes a hymn. And certain introductory prayers, like those of every *seventh day*, those of the Passover Seder, and those of Yom Kippur, whose 24 hours are dedicated to prayer and fasting, possess a poetic magic that is hard to remain indifferent to. When the sun rises, it merely extends this already established atmosphere, until twilight takes on the appearance of a farewell, a goodbye, but also the vigorous confrontation of a new day, The daily rhythm itself is turned upside down by this scheduling of the three prayers from one evening to the next: evening prayer, morning prayer, afternoon prayer. It is not the crow of the rooster that wakes a Jewish man to his day. It is the Jewish man who, from the eve, sings the Psalm of the human and cosmic day. Due to the fact that the days are anonymous, they escape the mythological or astral influences that their names impose on them in non-Jewish calendars. They are magnetized towards the seventh day, which alone bears a name: *Shabbat*, rest, concentration of human activity into a purifying core moment in time, absorbing past energies and infusing them with a new charge for the future.

But *Shabbat* is not just weekly. I seize time in all its pulsation and articulate it into a true temporal pyramid animated by the number seven. Every *seventh year* is a Sabbatical year. It requires the reclamation of the land, the cancellation of debts, the liberation of slaves, and the restoration of balance in agricultural and social life. At the end of the seven-year Sabbatical cycle, which amounts to forty-nine years, it is the Sabbath of the fiftieth year, the Jubilee year, whose redemptive power is even deeper than that of the Sabbatical year. I! It totals the requirements and crowns them with the return of the alienated land to its original owner. The man, having become a stranger to his heritage, finds himself once again in his original identity.

Measurement of a cyclical time, therefore, which has its origin in creation and its knots in the “returns” that are so many relays towards completion. Arbitrary measure, since it is independent of the cycles of nature. Each man and each human community chooses their Shabbat. Are you lost in the desert or in the polar regions, without contact with other Jews and have you forgotten what day of the week it is? So, you start counting for yourself on the first day, and the seventh will be your Sabbath. It is this relativity, this mobility of Shabbat that David Gans is one of the

first Jewish Masters to sense and fear, as they carry within them the risk of the disintegration of Shabbat.

Certainly, the medieval masters had anticipated this risk and, to prevent it forever, they had introduced a stable element into the arbitrary, a sort of standard, but this standard Shabbat no longer belonged to the categories of time but to those of space. It is the Shabbat of the Holy Land, Eretz Israel, Palestine; only this matters metaphysically, one might say. Just as Jews around the world turn their gaze towards Jerusalem at the time of prayer, so too is the Jewish soul oriented towards the Shabbat of Jerusalem, whose 24 hours constitute the absolute Shabbat. Likewise, the prescriptions of the sabbatical year and the jubilee year are only in effect within the boundaries of the Holy Land.

However, this thesis, admirably developed within the framework of a purely astronomical presentation by the poet-philosopher Judah Halevi in the 12th century, had already been refuted, for astronomical reasons, by Isaac Israeli two centuries later. Two centuries later still, maritime discoveries laid down, alongside mathematical motivations, their hefty bundles of empirical motivations, and the weight of the centrality of Erets Israél (“Land of the Israelites”), if it could maintain its integral value in the realm of metaphysical symbols, no longer played a role once one entered the purely physical confines of a world renewed by the joint repercussions of the cosmographic revolution and the astronomical revolution.

We saw that David Gans did not evade the issue: he raises it in his book, well before the "Prague Conference," specifically in chapters 89 and 91, regarding the new choice of a prime meridian. But we have also seen that unfaithful on this point, as on others, In his entirely metaphysical vision of his Master, the Maharal, he introduces the Holy Land into the secular cartography, thereby stripping Erets Israel of its magnetic power, and simultaneously bouncing back the issue of Shabbat, which he presents under the more general guise of the problem of the day, along with his non-Jewish astronomer masters from Prague. The desacralization of the Holy Land automatically leads to the desacralization of Shabbat, which is no longer just a 24-hour day like the others.

Chapters 99 and 152 of Gans' book are revealing on this subject. In chapter 99, Gans, in dialogue with Kepler, emphasizes the crucial difference between the Christian calendar, which has pagan roots and where the days of the week are, in their very names, influenced by the astrological presence of the planets: Sunday, Monday, Tuesday, etc., whereas the days of the Jewish week, being anonymous, are merely arrows pointing towards Shabbat. But in chapter 152, Gans specifies, conversely, that this Shabbat does not possess a benchmark power. The difference in longitudes leads to the fact that between the Shabbat in Jerusalem and that in Prague, there is an unbridgeable gap of one hour. The Sabbath thus falls into the category of natural measures of time. And if the Jewish week escapes the irrational magic of astrology, it is captive to the scientific rigor of astronomy. To rediscover the sacredness of Shabbat, — and through it, that of the Land of Israel — a solution is needed to the serious problem raised by David Gans. But if the Maharal can offer David Gans only a metaphysical key, the professional astronomers, Tycho Brahe, Kepler, and Muller, on their side, cannot provide Gans with any physical key.

And one understands David Gans' disappointment when he ends his long chapter with a question mark.

Let us admire, once again, the courage of David Gans, his confidence in tomorrows rich with promises that today cannot yet fulfill. The failure of the Prague Conference does not discourage him any more than the multiple failures of Tycho or Kepler discouraged them on their difficult path. Like his colleagues and mentors, David Gans gives naive and unlimited credit to science. What she doesn't know today, she will surely come to know tomorrow. And it is without any trace of shame, without blushing at either Jewish science or non-Jewish science, momentarily lost in the same dead end, that David Gans continues on his path. Shouldn't it have taken Christopher Columbus, Amerigo Vespucci, and Vasco da Gama two, three, or four expeditions to finally offer the land to men in such a way that it was entirely in their hands? One day, thanks to the repeated expeditions without respite by the navigators of the celestial vessel, they will also offer to mankind, so that it can hold the entirety of the sky in their hands.

Chapter 5.

The Summit Meeting: Tycho Brahe and the Maharal of Prague

While awaiting that blessed moment, perhaps provided by the Messiah, one must position oneself. Doesn't the Talmud often refer to the prophet Elijah, the forerunner of the Messiah, to underscore the gravity and reality of a currently insurmountable problem? It seems to us that it is within the logic of the Talmud, within this rabbinic notion of *tequ*, filled with humility but also confidence, that David Gans drew the general outline of the conclusion of his book.

The Conclusion of the *Nehmad Venaim*: The Tycho Brahe System

This conclusion, reserved for the end, begins—as we have transcribed it—by describing the wonder of the world that is the Benatek observatory and by recalling the exhilarating hours David Gans spent working in that observatory.

But the aim of this autobiographical account, *taklit hammesuppar*, is its scientific distillation: a summary as succinct and clear as possible of the astronomical revolution brought about by Tycho Brahe.

It is with this summary that David Gans concludes his book. It consists of four points, some of which have already been remarkably emphasized by the author within the body of his book, particularly in chapters 25 and 163:

1. Tycho Brahe demonstrated that the spheres are fixed and the stars are mobile (this is the entire content of the "key chapter" 25, designated here as no. 16 which announces it).

2. He demonstrated that over time, the sun has deviated from the regular curve of eclipses (the result of meticulous research conducted by Tycho Brahe at Uraniborg, cf. Dreyer, p. 357 ff.).

3. He provided irrefutable evidence that Mars, Mercury, and Venus are dependent in their orbits on the orbits of the other planets.

4. Indeed, the Earth is not the center of the spheres of the five main planets, namely Saturn, Jupiter, Mars, Mercury, and Venus. The Earth is only the center of the solar and lunar spheres. The center of the spheres of the other five planets is the sun itself. According to Tycho Brahe, the sun sits at their center like a king enthroned among the people of his servants who surround him with their circles. These planetary circles are immutable in their distance from the sun, and they form with it an eternal heliocentric system.

David Gans adds that no astronomer before Tycho Brahe had ever imagined such a system, both geo- and heliocentric. He continues by noting not so much the difficulty of the system but of its representation, which he would have liked to propose to the reader through appropriate figures. But here, his pen betrays him. It is not animated by the creative and evocative power that was Tycho Brahe's. Therefore, one must be content to refer to the works composed by Tycho Brahe himself. These are in the hands of David Gans, who invites the reader to come and consult them with him: just as he was, the reader will be dazzled by the convincing clarity of the figures drawn by Tycho Brahe, and a moment of attentive reflection will suffice to understand their implications and grasp their majestic logic.

The Astronomer

No astronomer had imagined such a system before Tycho Brahe!

We think that if, in the end, at the temporary milestone of his journey, David Gans places his bet on Tycho Brahe, it is not only because he was personally enchanted by the Danish astronomer. Another element intervened in David Gans' choice: it is that if, before Tycho Brahe, no one had indeed imagined such a system, at the same time as him, and in the same city of Prague where David Gans had become his disciple, David Gans' other master, the great Maharal, had essentially proposed an astronomical system similar to that of Tycho Brahe.

This is the system exposed by the Maharal in the sixth well of his *Beer Haggola*. We have previously examined only its methodological impacts on David Gans' journey. Here is now the probable impact on David Gans of the content of these pages.

The Maharal's Astronomical System

It is not without apprehension that we present this final hypothesis. The pages dedicated to astronomy by the Maharal in his *Beer Haggola* are so "sealed" that one hesitates to strip them of their mystical charge, as we are about to attempt, without fearing to profane them.

But what can we do? We are among those who, along with Kariv, Kleinberger, Dreyfus, and Gross, have tried to show that the Maharal's "theology" contains a key. Would his astronomy, an integral part of his theology, escape the general dialectical frameworks of his system?

Already, as we indicated above when we spoke exclusively about method, and when we addressed the remarkable passage where the Maharal fearlessly confronts the astronomical revolution brought about by Copernicus, the central figure of man had suddenly emerged—the central Adam, situated in the middle, exposed to the whims of physical causality and finality. A domain of variability. Now, here he is, still in the middle, but realizing the scale of metaphysical permanence between the inferior and the superior.

The turning point in the Maharal's thought is that the opposition between the inferior and the superior is not focused here exclusively on that of permanence and variability. Another polarity emerges, vigorously highlighted on several occasions: that of the Earth below, and that of the Sun above. The Earth, moreover, is round, occupying the center of the inferior universe. The Sun reigns in the superior world. It is separated from all the elements of the inferior world. Its very essence is to be separated from it. It is sovereign in the superior world.

This, as we can see, is almost word for word the phrase of Pliny, the vision of Copernicus, the exaltation of the Sun in relation to the other planets, a heliocentrism with a Pythagorean flavor, but which is inserted here antithetically into Ptolemaic geocentrism. The Earth-dwelling man and the Sun share the sovereignty of the worlds.

A tension typically Maharalian. Does the Maharal not repeat ad nauseam that man is not only the sovereign of the inferior world but also a participant in the superior world? The inferior and the superior are no longer two levels, each barricaded in on itself, as Aristotle would have it with his sublunary and superlunary worlds. A medium, an *emtsa*, welds them together. Hence, their bifocal structure: the Sun, the focus above; the Earth, the focus below.

Philosophically, this means that the metaphysical is intertwined with the physical and that everything participates simultaneously in both. Methodologically, this implies a blending of mysticism and reason, a global vision irradiating the universe with a gaze that involves both faith and science.

But, in a simpler projection on the purely astronomical level, this tension resolves into a compromise, a *hashlama*, as the Maharal would say, between heliocentrism and geocentrism. Isn't this the very compromise that Tycho Brahe arrived at in his desperate search for coordination between Copernicus and Ptolemy? The planets revolve around the Sun, but the Sun and its entourage revolve around the Earth—this seems to be the strictly "physical" distillation of the Maharal's "metaphysical" system. The tangible sign of this dual function of the Sun is its visibility during the day, its retreat during the night; it is also its warm radiation in summer, its insensitivity in winter. All this is experimentable, measurable in the physical edge of the universe. But here, as everywhere, the physical datum is only the indication of a supernatural truth, precisely probed by the Sages of Israel in their astronomy. Thus, the physical contradiction between an apparent Sun and an underground Sun, between a southern Sun and a northern Sun, is found, amplified, extended to the limits where the finite and the infinite merge—between a

sovereign Sun and a sovereign Earth, disputing the empire of creation and each carving out its own share.

For the physical observer, perched on his small earthly parcel, everything happens as if the entire system of spheres revolved around the Earth. But for the eyes of the true man, of that Adam whose dimensions embrace both the lower and the upper, and who reaches vertiginous heights with even more reality as he knows how to descend more intensely into the depths of his nothingness—for him, a living creature facing the living Creator, a fissure appears in the cosmos, a polarity emerges: the Earth, around which the Sun and the spheres revolve, but also the Sun, around which the spheres revolve, connected to it by the law of opposites that attract.

The Irrational Obsessions of the Maharal and Kepler

A grand vision, expressed in language heavy with symbols, but one whose every detail and term could, in the end, be translated into scientific laws and propositions. Whether they are true or false is not the question.

What is fundamental is that the Maharal was the only Jewish thinker animated by "this irrational obsession" (Koestler), so characteristic of the *Weltanschauung* of his contemporaries, Tycho Brahe and Johannes Kepler, from which, through an internal process of their genius, scientific explication emerged.

Let us recall Kepler's persistent taste for what he calls the "geometry of the Kabbalah." He discusses it in a letter sent from Prague on May 12, 1608, to Professor of Anatomy and Surgery in Leipzig, Joachim Tanckius (Werke, 16, 158, letter 493). It is worth transcribing it here, as we touch upon the spiritual interferences of the Maharal, Tycho, and Kepler:

"I too, indeed, play with symbols, and I started a little work, the Geometric Kabbalah, which is about the ideas of natural things in geometry: but I play in such a way that I do not forget that I am only playing. For nothing is proven by symbols, nothing abstruse is unearthed in natural philosophy by geometric symbols; only previously known notions are accommodated to them."

These few lines are characteristic of the coexistence in Kepler of "two souls," one rational, deductive, mathematical; the other mystical, inductive, meta-scientific. And this latter one seeks and finds its methodological supports in the methodology of Jewish mysticism: Kabbalah, geometry (which should be understood in the Hebrew sense of gematria; we have already noted that Kepler knew Hebrew), symbols.

1608: this is the year when Kepler finished his *Astronomia Nova*, which was published the following year. The *Beer Haggola* by Maharal had already been published in 1600, but Maharal was still alive, and the two authors had the opportunity to meet in Prague. And Kepler remained in the wake of Tycho Brahe.

Without a doubt, and this is extremely important, Kepler insisted that the symbolism of the Kabbalah was, for him, just a game. This is the fundamental difference between Kepler and Maharal. What was merely a game for the former, and he never forgot this, was for the latter a profoundly serious truth. But beyond this difference in conception between two minds for whom Kabbalah is either a playful exercise or a philosophical reflection, there remains the convergence of these minds within the universe of Kabbalah and its modes of expression.

With Maharal, scientific explanation is not clear, likely because he did not intend for it to be. He was satisfied with the intimacy of the "secret" of creation, without feeling the need or having the ability to describe this secret in mathematical terms. However, let us repeat, the outline he traces in these few pages evokes, without ambiguity, Tycho Brahe's system.

As for the evidence of the kinship between Maharal's vision and Tycho Brahe's theory, we have it precisely in David Gans. His introduction to the seventh part of the *Nehmad Venaim* and the "ultimate conclusion" of his book allow us to support our hypothesis based on texts written by someone who was the close confidant of both Masters, one Jewish and the other non-Jewish, whose brilliance illuminated Prague around the year 1600.

The System of David Gans: Snapshot of the Spiritual Encounter between Maharal and Tycho Brahe

In chapter 163 of his book, the first of this seventh part dedicated to the description of the movement of the planets, David Gans explains why he begins his exposition with the presentation of the sun's orbit, even though the solar sphere is only the fourth among the seven celestial spheres.

It is because—literally themes borrowed from Maharal—the number four is positioned in the middle (*emtsai*) of the count of the seven. Thus, the other spheres depend on the solar sphere, since the middle supports and explains the whole. This median and mediating position of the sun was compared by the Sages to that of a King around whom his servants revolve, carrying out their functions according to the orders they receive from him. David Gans does not specify the names of these "Sages." They are evidently the Ancients, particularly Pliny and the Pythagoreans, whom Gans sees as the forerunners of Copernicus. But the term also implicitly includes Maharal, from a dual perspective: the metaphor of the Sun-King is found, as we have just seen, explicitly in the *Beer Haggola*; moreover, the notion described in the *Beer Haggola* of a sun separated from all other beings is conflated in Maharal's cosmology (see our *Well of Exile*) with the metaphysical function of the middle. What is in the middle is separate (*nivdal*), metaphysical, or, in the case of the sun, meta-terrestrial. It seems that through David Gans' lines and the terminology of Maharal he employs, it is indeed the thought of his Jewish Master that is unmistakably evoked.

Immediately following is the explicit mention of the non-Jewish Master: "And according to the opinion of the great researcher Tycho Brahe, the central position occupied by the Sun constitutes the (astronomical) center of five (of the seven) planets, a hypothesis -

1. When, in his very legitimate polemic against the "Germanization" of Copernicus by E. Zinner, Koyré writes (p. 103) that "the phrase about the role of the Sun is a banality," he exceeds the limits of a psycho-sociological reality

that he himself had excellently described earlier (p. 69). "The emotion with which Copernicus speaks of the Sun..." (I add: his metaphor of the Sun-King: "Thus, indeed, as if seated on a royal throne, the Sun governs the family of stars revolving around it" *De Revolutionibus*, I) are neo-Platonic and neo-Pythagorean reminiscences. This is evidently the spiritual world in which Maharal also lived, the world of Jewish Kabbalah. But it remains that anyone discussing astronomy in the context that establishes without any doubt that the author knew Copernicus' revolutionary theories, anyone, I say, who then uses the metaphor of the Sun-King, supports his "heliolatry" (Koyré) as much and more on Copernicus himself as on a diffuse mystical atmosphere. This, I am convinced, is the case with the three Jewish authors who implicitly cite Copernicus' theories and simultaneously use the Sun-King metaphor: Maharal (*BH* 129a), David Gans (*NN* 163), and Joseph Solomon Delmedigo (*Elim*, p. 300). With the latter, the metaphor is, moreover, a literal citation of Copernicus translated into Hebrew.

- which none of the scholars who preceded him had ever formulated. An admirable concept on which I will return in a few words as the ultimate conclusion of this book." A conclusion that culminates, as we have just seen, in the exposition of Tycho Brahe's system in terms common to both Tycho's and Maharal's terminology.

Thus, through the testimony of David Gans, the similarity, if not the identity, of the astronomical theories of Maharal and those of Tycho Brahe is established.

Perhaps the mysterious 1592 dialogue between Rudolph of Habsburg and the Maharal of Prague was about nothing other than this new discovery of the heavens. Behind the veil that separated the Emperor from the Maharal, another veil was lifted, dazzling Rudolph with the brilliance of the cosmos, suddenly revealed to him. Tycho Brahe had not yet arrived in Prague. Nor had Johannes Kepler. And perhaps Emperor Rudolph received the first data of the "astronomical revolution" not from his official "imperial mathematicians," but from the venerable old Rabbi, vibrant with Kabbalah and mysticism as much as with science and rational knowledge.

In his novel *Tycho Brahe: In Search of God*, Max Brod has the astronomer and the Rabbi meet precisely at the moment of the 1592 audience. Tycho Brahe enters the Hradschin and crosses paths with the majestic figure of High Rabbi Loeb just as he is leaving the room where Emperor Rudolph has just listened to him. And Tycho Brahe feels that the old Jewish man holds the key to the secret that he, the non-Jewish scholar, suffers from not being able to discover. The scene is, of course, fictional, since the meeting between Maharal and Rudolph took place in 1592, and at that date, Tycho Brahe had not yet arrived in Prague, where he would not settle until 1599. But this scene surely contains a part of truth: the truth of the spiritual encounter between Maharal and Tycho Brahe. This encounter was not only symbolic or folkloric. It represents a real moment in the history of astronomy and its transition from the medieval stage to its modern aspect. And it is not the least of the merits of David Gans' book to offer us, as a vivid testimony, what could well be called the snapshot of this moment.

1. Did a meeting take place between Maharal and Tycho Brahe between 1599 and 1600? We do not know, and we will likely never know. What is certain is that the stories associating Maharal with Tycho Brahe in the *Sippurim* by L. Weisel (Prague, Pascheles, 1847) all belong, like those of the Golem, to myth, and F. Thieberger (o.c., p. 82) was right to mention them in the part of his book titled *The Legend*.